ENGINEERING CONSTRUCTION WEEKLY

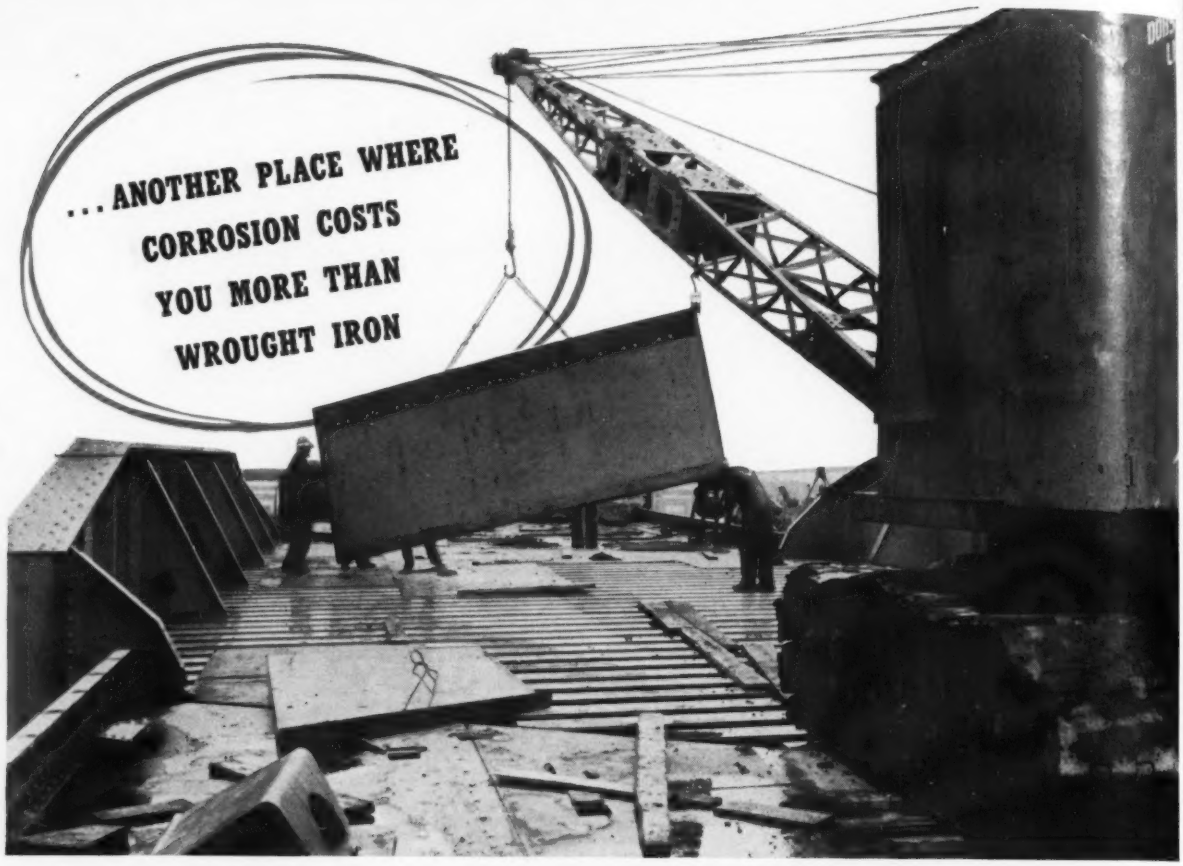
ENGINEERING NEWS-RECORD

JAN 15 1940

DECEMBER 7, 1939

Section of watermain for a new crossing under the Kennebec River at Bath, Maine.

Difficult Underwater Pipelaying · Raising a Highway Bridge [illegible] Tennessee River · Putting New Piles Under an Old Wharf · Point-[illegible]ted Concrete Dome of Thin-Shell Type · For full contents see page 49.



DECK PLATES ON THIS LINCOLN, NEBRASKA, BRIDGE ARE

BYERS WROUGHT IRON

In every structure, certain parts are subject to more rapid deterioration than others, due to unavoidable corrosive conditions. Deck plates in bridges are one such vulnerable application.

Brine drippings from refrigerator cars, drainage from rain and snow, and atmospheric corrosion all combine to put these plates on the spot. In this railroad bridge at Lincoln, Nebraska, engineers met the situation in a time-proven way, by installing deck plates of Byers Wrought Iron. The long maintenance-free service life of Byers Wrought Iron is of particular value here, because deck plates are not readily accessible for regular inspection and maintenance.

Engineers intent on well balanced bridge designs use wrought iron in other vulnerable spots as well; cover and protection plates . . . blast plates . . . railings . . . and pier protection plates. In each of these applications, service records have definitely proven that corrosion costs more than wrought iron.

Perhaps you have a problem in bridges or other structures, or in heating, plumbing or process services, where corrosion is causing trouble and expense. If you will write us the details, our Engineering Service Department will (1) Determine the probable corrosive conditions; (2) Relate these to similar conditions encountered elsewhere; (3) Interpret the results in the light of 75 years' experience with corrosion problems; and (4) Make recommendations . . . supported by service records. Ask, also, for a copy of our bulletin, "Wrought Iron in Bridge Construction."

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

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TUBULAR AND FLAT ROLLED PRODUCTS

Specify Byers Genuine Wrought Iron Pipe for corrosive services and Byers Steel Pipe for your other requirements

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewers, Waterworks, Bridges, Highways, Streets, Dams, Foundations, Earthwork, Flood Control, Public Works, Irrigation, Canals, Railroads

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THIS WEEK

● For the fourth time the city of Bath, Maine, has laid a pipe crossing under the swift waters of the Kennebec River. This issue tells how modern developments in pipe and pipe laying have been used to advantage in the latest work.

● Renewal of piles under a wharf always presents a difficult problem for marine contractors. How H-section steel piles were used at Long Beach, Calif., is described on p. 68.

● Ingenious methods were used by engineers of the TVA in raising a large bridge over the Tennessee River as much as 17 ft. to clear the new reservoir behind Guntersville Dam. Bridge engineers will find valuable information in the report of how the continuous trusses behaved.

● Thin-shelled domes are receiving wide attention as an addition to the design resources of engineers and architects. One type was described in our issue of Nov. 9, p. 59; a different type is described on p. 85 of this issue.

● Foundation men as well as subway builders will find valuable data in the account of soil explorations carried out for the Chicago subway, p. 87.

● Our news pages of Nov. 23 reported briefly on a fast pipe-laying job at Little Rock, Ark. This issue, p. 89, gives more details.

THINGS TO COME

THE FIRST ARTICLE on divided highways, originally scheduled for this issue, is to be published in the Dec. 21 issue.

THE QUEENS-MIDTOWN vehicle tunnel at New York was holed through on Nov. 8. Construction methods will be described in the Dec. 21 issue.

BEGINNING IN JANUARY, a series of articles on the use of electrical equipment in every-day construction.

RYERSON CERTIFIED STEELS

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Combined deliveries from the world's largest and most diversified steel stocks save time and trouble as well as money. There is no delay on the job—no idle hands waiting for steel—and the work goes forward as scheduled.

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- Concrete Reinforcing
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CONTRACTS AND CAPITAL

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	November† 1938 (4 wk.)	November† 1939 (5 wk.)	% Change	Eleven Months† 1938 (47 wk.)	Eleven Months† 1939 (48 wk.)	% Change
Total	$217,023	$302,215	+11.0	$2,452,681	$2,812,529	+12.3
Private	45,758	111,632	+95.0	741,099	829,165	+10.0
Public	171,265	190,583	−11.0	1,711,582	1,983,364	+14.0
Federal	30,085	34,857	−7.0	328,395	331,541	−1.0
Total New Productive Capital	$207,596	$119,491	−54.0	$3,560,046	$2,352,917	−35.0
Private Investment	99,081	116,042	−0.0	948,638	735,748	−24.0
Federal (non-federal work)	108,465	3,449	−97.0	1,467,713	489,141	−67.0
Federal (federal work)	50	.....	.....	1,143,695	1,128,028	−3.0
FHA Mortgages Selected for Appraisal	$84,141	$82,415*	−2.0	$933,680	$1,059,717*	+13.7

† Adjusted for difference in number of weeks. * Preliminary.

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	December 1938	December 1939	% Change	Change November to December 1938 Nov.	1938 Dec.	1938 %	1939 Nov.	1939 Dec.	1939 %
E N R Construction Cost Index, 1913 = 100	234.89	238.17	+1.3	234.40	234.89	+0.2	238.20	238.17	0
E N R Building Cost Index, 1913 = 100	196.07	201.21	+2.6	195.58	196.07	+0.3	201.24	201.21	0
ENR 20-CITIES' AVERAGE									
Common Labor	$0.682	$0.685	+0.4	$0.682	$0.682	0	$0.685	$0.685	0
Skilled Labor (Av. 3 trades)	1.427	1.463	+2.5	1.427	1.427	0	1.463	1.463	0
Bricklayers	1.514	1.563	+3.2	1.514	1.514	0	1.563	1.563	0
Struct. Ironworkers	1.479	1.519	+2.7	1.479	1.479	0	1.519	1.519	0
Carpenters	1.288	1.306	+1.4	1.288	1.288	0	1.306	1.306	0
Cement, per bbl	$2.56	$2.60	+1.6	$2.57	$2.56	−0.4	$2.60	$2.60	0
Reinforcing steel, per cwt	2.48	2.57	+3.6	2.48	2.48	0	2.56	2.57	+0.4
Struct. Steel, base	2.10	2.10	0	2.10	2.10	0	2.10	2.10	0
Sand, per ton	1.23	1.20	−2.4	1.24	1.23	−0.8	1.20	1.20	0
Lumber, 2x4 Fir, per M ft	32.67	35.09	+7.4	32.38	32.67	+0.9	35.09	35.09	0
Lumber, 2x4 Pine, per M ft	29.21	31.71	+8.6	28.59	29.21	+2.2	31.77	31.71	−0.2
Brick, Common, per M	13.86	14.39	+3.8	13.87	13.86	−0.1	14.39	14.39	0
Ready-mixed Concrete, c.y.	7.14	7.11	−0.4	7.13	7.14	+0.1	7.10	7.11	+0.1
Struct. Clay Tile, 3x12x12	74.48	73.68	−1.1	74.08	74.48	+0.5	73.68	73.68	0
Paving Asphalt, cars, ton	14.16	13.95	−1.5	14.11	14.16	+0.4	13.77	13.95	+1.3

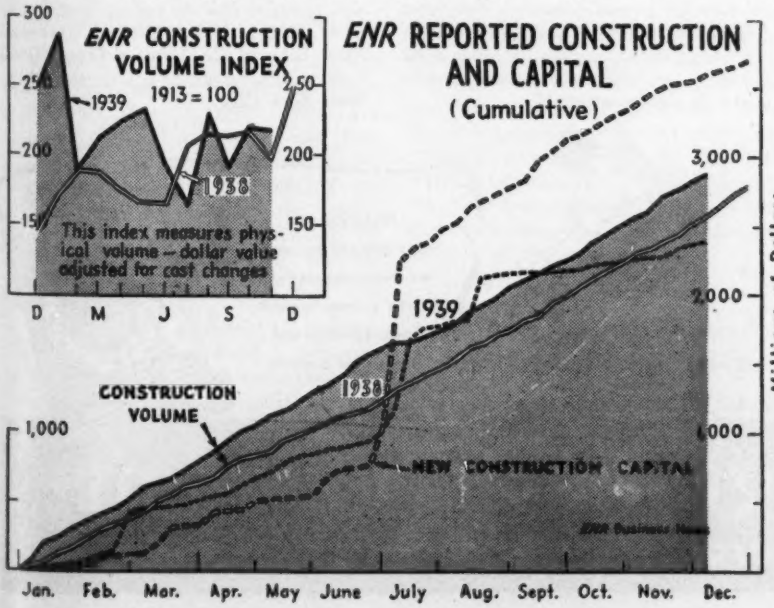
MATERIAL SHIPMENTS . . . BUILDING PERMITS

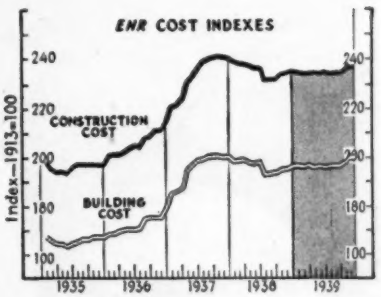
	November 1938	November 1939	% Change	October 1939	% Change Oct.-Nov.
Lumber (% 1929 wk. seas. av.) N.L.M.A.	62.8	78.0	+24.2	79.0	−1.3
Steel (% operating capacity) A.I.S.I.	61.6	93.6	+52.0	90.0	+4.0

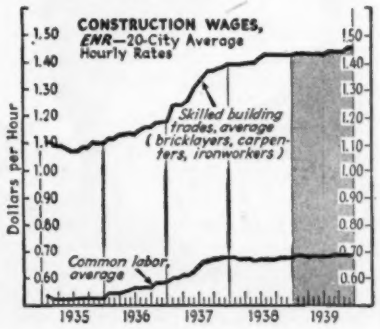
	October 1938	October 1939	% Change	Ten Months 1938	Ten Months 1939	% Change
Fabricated Struct. Steel, tons, A.I.S.C.	105,032	129,321	+23.0	952,434	1,191,129	+25.2
Cement, thous. bbl., U.S.B. of M	12,357	12,830	+3.8	92,670	105,358	+13.7
Building Permits, Dun & Bradstreet, (,000 omitted)	$97,112	$117,878	+21.4	$968,302	$1,063,054	+9.8

RENT INDEX . . . EMPLOYMENT

	October 1938	October 1939	% Change	Sept. 1939	% Change Sept.-Oct.
Rent (Housing) Index, N.I.C.B.	86.6	86.6	0	86.5	+0.1
All Trade Unions, % Employed, A.F.L.	85.0	89.0	+4.7	89.0	0
Building Trades, % Employed, A.F.L.	68.0	74.0	+8.8	75.0	−1.3






CONSTRUCTION WAGES,
ENR—20-City Average Hourly Rates
Dollars per Hour
Skilled building trades, average (bricklayers, carpenters, ironworkers)
Common labor average
1935 1936 1937 1938 1939

CONTRACTS

(Thousands of dollars)

	Week Ending Dec. 8 1938	Nov. 30 1939	Dec. 7 1939
Federal	$7,912	$6,674	$4,557
State & Municipal	47,451	30,105	32,532
Total public	$55,363	$36,779	$37,089
Total private	9,436	20,722	20,650
TOTALS	$64,799	$57,501	$57,739
Cumulative 1939 (49 weeks)	$2,870,268		
Cumulative 1938 (49 weeks)	$2,585,616		

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1938 49 Wk.	1939 49 Wk.
NON-FEDERAL	$2,528,321	$1,251,999
Corp. securities	372,209	208,587
State & Mun.	683,500	540,107
R.E.A. loans	67,495	89,445
R.F.C. loans	100,344	8,049
P.W.A. allot.	838,219	.....
U.S.H.A. loans	265,054	215,811
Fed. Aid—Hwys.	201,500	190,000
FEDERAL	$1,143,695	$1,128,028
TOTAL CAPITAL	$3,672,016	$2,380,027

FHA MORTGAGES

	Week Ending Dec. 3 1938	Nov. 25 1939	Dec. 2 1939
Selected for appraisal	$19,324	$16,133	$19,064*
Cumulative 1939 (48 weeks)	$1,059,717*		
Cumulative 1938 (49 weeks)	$ 948,334		

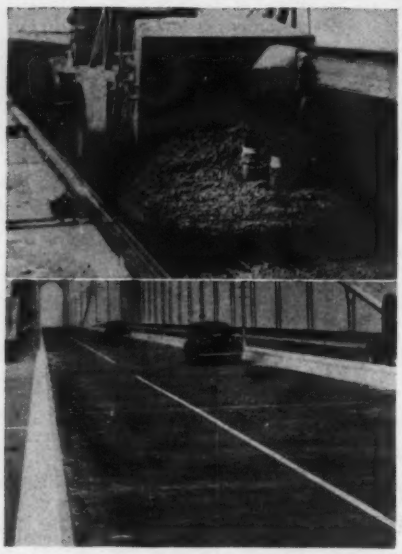
* Subject to revision.

ENR INDEX NUMBERS

	Construction Cost			Building Cost		Volume	
Base = 100	1913	1926		'13	'26	'13	'26
Dec., 1939	238.17	114.49		201.21	108.77	...	...
Nov., 1939	238.20	114.50		201.24	108.78	219	96
Oct., 1939	236.86	113.87		198.50	107.31	222	97
Dec., 1938	234.89	112.87		196.07	105.99	249	109
Nov., 1938	234.40	112.69		195.58	106.71	199	87
1939 (Av.)	235.51	113.21		197.44	106.73	...	...
1938 (Av.)	235.86	113.34		196.53	106.40	197	86
1937 (Av.)	234.71	112.66		196.15	106.07	172	75
1936 (Av.)	209.42	99.15		172.18	93.14	185	81

November Construction Table on page 59

Cut Costs, Speed Work... Use Atlas High-Early cement for cold-weather construction!



Top: *Placing Atlas High-Early Concrete.* Note its easy workability and freedom from segregation. Atlas High-Early gives you time enough to place it properly, sets rapidly, gains full strength quickly.

Bottom: *Race against time* won on the Bronx-Whitestone Bridge, New York City, despite cold weather, thanks to Atlas High-Early cement.

ENGINEERS and contractors have found that it pays to specify and use Atlas High-Early cement for cold-weather concrete. Even though this cement is slightly higher in initial cost, frequently you offset that *before you finish construction.* For Atlas High-Early cement makes possible important savings that in the long run may spell greater profits. And here's how:

Speeds Construction—Atlas High-Early cement gains strength several times faster than normal portland and so permits earlier use of concrete. You finish jobs faster, cut overhead costs, and release tools and machinery for other work. (Handy, too, when you have a penalty clause in your contract!)

Saves on Forms—As forms may be struck more quickly, frequently within 24 hours, fewer sets of forms may be needed.

Cuts Time Required for Protection and Curing—as much as 60% to 70%.

Promotes Winter Construction—Because of these factors, Atlas High-Early cement makes it economical to do work during the winter which might otherwise be postponed.

Consider these factors in studying the cost and time factors on your next job. You may be able to reduce costs, save time, and increase profits. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), Chrysler Bldg., New York City.

When you use this cement for cold weather concrete you take a jump toward lowered costs and increased profits!

NR-H-2

Atlas High-Early Cement

A UNIVERSAL ATLAS PRODUCT

ENGINEERING NEWS-RECORD

Volume 123 DECEMBER 7, 1939 Number 23

Patten Replaces Miller As Georgia Highway Head

L. L. Patten, Lakeland, Ga., has been appointed by Governor Rivers of Georgia to replace W. Linton Miller as chairman of the Georgia State Highway Board. The governor said that Miller was using the prestige and power of his office to build a governorship campaign.

Miller had to be forcibly removed from his office and has stated he will fight to retain his old position.

• • •

Transit Firms Pay $3,000 For Damages to Bridge

The R. & W. Transit Co. of Gastonia, N. C., and the McCoy Service Co. of Charlotte, N. C., have paid the North Carolina highway and public works commission $3,000 for repair of the Ida Mill Bridge on U. S. Highway 74 between Laurinburg and Laurel Hill, which was damaged by fire when two gasoline trucks collided on the structure.

• • •

Wright Resigns as Head Of Grand River Project

R. V. L. Wright, general manager of the $20,000,000 Grand River project in Oklahoma, has resigned, following a public hearing Dec. 1 at Vinita, Okla. The board of directors of the Grand River Dam Authority had charged that Wright was failing to push the project at a satisfactory speed (*ENR*, Nov. 23, 1939, p. 671) and contended that the project would not be completed by Jan. 1 as scheduled.

Before Wright presented his resignation, his attorney obtained a statement from the board that there was no charge of corruption in office nor any reflection concerning Wright's ability as an engineer.

Wright was named general manager of the project at the request of Secretary Ickes when he was head of PWA.

High Costs May Stop Ohio Highway Work

Unless material costs level off soon, Robert S. Beightler, director of the Ohio state highway department, has threatened to stop his department's construction program. Commenting on present conditions, he stated: "This thing may be worked out satisfactorily. One thing is certain, however, I am not going to pay war prices for the road work.

Contractors, he stated, are reluctant to submit bids on jobs which could not be completed until next year, and as a result the department cannot get bids at normal cost.

The problem became more acute on Nov. 28 when no bids were received on three projects estimated to cost $175,000. The department on Dec. 16 will attempt to obtain bids on a large project located in Cuyahoga and Geauga counties, two previous requests having produced no bids.

• • •

Appeal to Be Heard In High Point Case

Oral arguments for the repeal of a court ruling, which halted work on the $6,500,000 hydro-electric project at High Point, N. C., will be heard by the North Carolina Supreme Court Dec. 15. The order restraining the city from proceeding with the work was signed by a judge in the superior court and followed action brought by the Duke Power Co. and the Yadkin County board of commissioners, two cases having been consolidated to expedite the hearing of the appeal.

• • •

Strauss Statue Proposed For Golden Gate Bridge

A bronze statue, costing $10,000, to be erected on the toll plaza of the Golden Gate Bridge in memory of J. B. Strauss was authorized at the Nov. 29 meeting of directors of the Golden Gate Bridge and Highway District.

Planners Discuss Radburn Experiment

Community planning and deficiencies in zoning practice are studied at New Jersey meeting

An evaluation of the Radburn, N. J. planned community enterprise respecting its lessons for city planners, was outlined before a conference of the New Jersey Federation of Official Planning Boards on Nov. 30. The meeting was held at Radburn, which is now in its tenth year and represents the first large-scale attempt in this country at scientific suburban development. Other papers dealt with zoning practice, the Forest Hills Gardens project on Long Island and planning activities at the World's Fair.

The Radburn experiment

Clarence S. Stein, architect and town planner, and former chairman of the New York State Commission of Housing and Regional Planning, stated that

(Continued on page 54)

• • •

Minnesota to Recover $131,000 from Contractor

A jury last week ruled that the S. J. Reader Co., Minneapolis contracting firm, must return to the state of Minnesota $131,000 due as over-payment to the contracting company on highway contract allegedly awarded without advertising for bids. Named as defendants with the firm were: S. J. Reader; N. W. Elsberg, former highway commissioner; L. L. Allen, former maintenance engineer, and John T. Flanagan, former highway department administrative assistant.

The award was $31,000 more than the total offered the state by the Reader Co. during previous criminal actions and the state had sought $157,000.

A 40-day stay has been granted the defendant to allow for an appeal.

Planners Discuss

(Continued from page 53)

the ideas experimentally developed at Radburn are influencing planning throughout the country in regard to separation of pedestrian and automobile traffic, the use of the super block, and the orientation of houses to face gardens and parks instead of highways. (See *ENR*, Feb. 16, 1928, p. 293 and Mar. 15, 1928, p. 426). Many governmental and privately financed developments, such as Green Belt, Md. and Chatham Village in Pittsburgh, were said to have followed basic principles of planning used at Radburn.

As a financial venture, the building of Radburn was badly timed, according to Mr. Stein, because of the depression. The 1,250 acres of land bought in the period of 1927-29 for as much as $2,600 an acre declined in some cases to 20 per cent of its original value. Conceived as a city in which the neighborhood units would ultimately provide for 25,000 people, the population has reached only about 1,500. The project is financed by the City Housing Corp., a limited-dividend company organized for experimentation in planning and building communties.

Many of the newly planned community projects are based on Radburn principles and objectives, said John O. Walker, director of the resettlement division of the Farm Security Administration and former manager of the Radburn Association. Mr. Walker reported that the resettlement division now has 170 projects under its jurisdiction.

Zoning and property values

Reporting on the results of a survey on zoning in relation to property values made by the New York Regional Plan Association, W. Philip Shatts, field secretary, said that a fair appraisal of zoning would indicate that it has proven to be one of the most useful social inventions in preserving human and economic values in cities. However, he continued, it must be admitted that zoning has fallen far short of what might reasonably have been expected of it, due largely to the fact that in order to be accepted in its early stages many compromises had to be made. Further, there was no experience to guide original efforts, and appropriations for doing an effective job were inadequate. The Regional Plan Association *Bulletin* No. 43, dealing with re-zoning, lists the outstanding shortcomings of this practice.

Speakers on the World's Fair planning activities were Charles Butler, member of the board of design, and Henry Dreyfuss, designer of the World of Tomorrow exhibit in the Perisphere.

• • •

Dallas Zoning Ordinance Upheld in Court

The zoning ordinance of Dallas, Tex. withstood another test Nov. 29 when the Texas Supreme Court refused to grant a review of litigation attacking validity of the ordinance. The plaintiffs, property owners of North Dallas, were originally denied a writ of mandamus in the ninety-fifth district court. The denial was upheld by a court of civil appeals.

The plaintiffs also sought to force the city to change the zoning classification of their district from a dwelling area to a commercial area and contended that a valuable right had been lost because no board of appeals for review of zoning cases had been created by the city.

WORLD'S LONGEST BELT CONVEYOR WILL BRING AGGREGATES TO SHASTA DAM SITE

MATERIALS from the Shasta Dam aggregate plant near Redding, Calif., will take a 9.6-mi. ride across country to the dam site on the longest conveyor belt system ever built. An artist's sketch of the belt route is shown above.

Capacity of the system will be 1,100 tons per hr. while conveying at a speed of 550 ft. per min. Material in transit will be on the conveyor an hour and forty minutes between the gravel plant and the dam. About 4 years of operation are scheduled for the conveyor.

Contract for the job calls for more than 20 mi. of 36-in. 6-ply belting. The conveyor system will comprise 26 units, each consisting of an endless vulcanized belt about ¾ mi. long, driven, with three exceptions, by a 200-hp. electric motor. Three down-grade chutes will be used for generating power. Aggregate haul will begin at an altitude of 490 ft., carry through a pass at 1450 ft. and deliver to the silos of the dam's concrete plant at 650. The system will be erected on wooden bents varying in height above the ground from 4 to 90 ft., and will utilize 12,500 steel troughing idlers. Steel chutes will be used for dumping from link to link at the junction points.

When completed the system is to be illuminated its entire length with sodium vapor lights. A motorized patrol will be on duty constantly. During the rainy season a temporary cover will be built over the system to protect the sand.

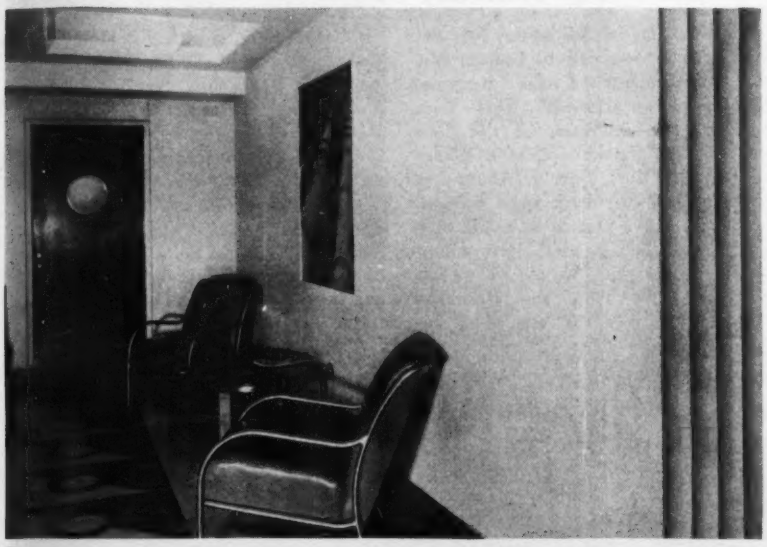
The Columbia Construction Co. sublet the contract for belting for the conveyor system to the Goodyear Tire and Rubber Co., Akron, Ohio.

Arkansas Road Act Held Unconstitutional

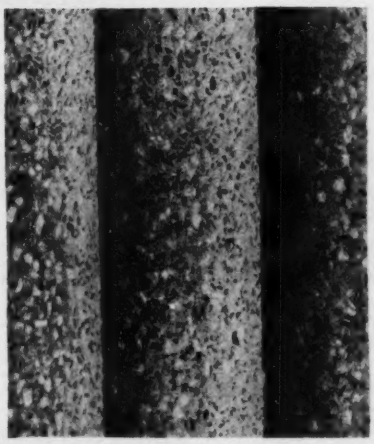
The Arkansas Supreme Court on Nov. 27 ruled unconstitutional the 1939 act which restricted aid from the state highway turnback fund to two Phillips County road districts. The decision affirms a Pulaski chancery court decision.

Under a 1937 act, the road districts were allowed a portion of the turnback revenues to retire bonds issued after Feb. 4, 1927. This law was amended by the 1939 act to restrict such aid to bonds issued between Feb. 4, 1927 and March 1, 1928. The lower court ruled that only two districts in the state, both of them in Phillips County, could qualify for aid under such a restriction. The supreme court ruled that this made the 1939 act a local measure rather than statewide and therefore unconstitutional.

Dressed Up for Fiftieth Anniversary



SYMBOLIC OF DEVELOPMENTS that have taken place in the manufacture and utilization of portland cement during the 50 years since the Universal-Atlas Cement Co. was founded is the new entrance lobby to this company's New York office, which is finished with thin precast architectural slab walls. Made with exposed aggregates, welded reinforcing and white cement, which, in addition to its binding function, provides a background that sets off the aggregates in their true colors and textures, the slabs are a creation of John J. Earley, of Washington, D. C. The accompanying views show the lobby and a close-up of the surface of one of the fluted pilasters.



In undertaking the promotion of cement as an architectural medium, as part of the observance of the fiftieth anniversary, the company recalls other developments in which it has pioneered —the use of powdered coal in the production of clinker, the use of plaster of Paris or gypsum for retarding the setting time of cement, the use of granulated blast furnace slag in place of clay or shale, the manufacture of white cement, and the introduction of the rotary kiln and the first high-early-strength cement.

The slabs, fluted pilasters, and curved angle shapes required for the lobby were made in molds laid face down into which the surface concrete, using aggregates of crushed quartz, was first placed. Welded reinforcing was next installed, after which the 2-in. slab was completed with a concrete of less expensive aggregate. Before casting the slabs, anchors for attaching them to the wall were fastened to the reinforcing steel. After removing the slabs from the mold, the surface was brushed and washed to reveal the aggregates.

A.G.C. Chapter Indicted on Bid Fees

New Orleans contractors charged with fraud in connection with PWA hospital contract bids

The New Orleans Chapter of the Associated General Contractors of America and sixteen member firms and individuals were charged with fraud and violations of federal statutes by a United States grand jury on Dec. 2 in connection with operations of the chapter's bidding fee plan as applied to the foundation contract for the New Orleans PWA charity hospital project. The two specific allegations made in the indictments are: (1) that the association and its members bidding on the job conspired to defraud the United States under Sec. 88, Title 18, U. S. Code; and (2) that the procedure alleged (bid fee practice) was an offense under Sec. 9, Federal Emergency Relief Act, in that it resulted in diversion of monies appropriated by Congress to a purpose other than for which they were appropriated.

(Editor's Note: In the bidding fee system, each bidder agrees in advance to add to his bid an agreed arbitrary amount to cover the cost of bidding of all bidders. The successful bidder turns over the entire amount to the association, which, in turn, distributes equal shares to the unsuccessful bidders, keeping the successful bidder's share as a fee for handling the transaction.)

It is charged that the New Orleans chapter has a rule, under which there is added to each bid submitted by a member, a fee for the chapter plus survey and estimating fees for all bidders. Furthermore it is charged that the usual fees for the project were doubled and, as a result, each of the defendants submitted bids to which over $7,500 in such fees had been added. In addition, it is alleged R. P. Farnsworth & Co., Inc., successful bidder, paid these extra fees to the chapter, the chapter paid each of the defendant corporations their pro-rated share of the fee and the W. F. Jackson Co. (not a defendant in the case) $840 for quantity survey costs.

Those indicted include:

R. P. Farnsworth & Co., Inc. and O. J. Farnsworth, its president; W. Horace Williams Co., Inc., and W. Horace Williams; Summa Caldwell and Monte E. Hart (Caldwell Brothers & Hart); Doullut & Ewin, Inc., and James P. Ewin; Herman T. Makofsky; Lionel F. Favret; T. A. Pittman of Pittman Brothers, a partnership; Henry Boh, Arthur Boh and Arthur Lagarde, and Robert Burkes and John Burkes, of Burkes Bros.

A. L. Gemeny Dies; Prominent Bridge Engineer

Albin L. Gemeny, senior structural engineeer of the Public Roads Administration, Washington, D. C., died Dec. 1 at his home from coronary thrombosis after an illness of less than 48 hours. One of the most brilliant young men on the PRA staff, Gemeny was widely known by virtue of his chairmanship of the bridge committee of the American Association of State Highway Officials. Born in Knoxville, Tenn., he received the degree of civil engineer at the University of Virginia in 1911. First employed as bridge engineer by the Southern Railway Co. he went with the Interstate Commerce Commission in 1914 on railway evaluation work, where he remained until 1920 except for two years in France as an officer at the front supervising road and bridge work. Entering the Public Roads Administration as bridge engineer in 1920, he continued with this organization until his death, with the exception of two years when he was engaged in bridge construction in Mexico and as field engineer for the Portland Cement Association. He often represented the PRA in cooperative research relating to highway bridge design, one of the most notable projects being the Rogue River concrete arch bridge in Oregon, first of the Freyssinet type built in this country. His most lasting contribution was probably made in connection with the drafting of the present highway bridge specifications.

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First Planning Medal Awarded George McAneny

A bronze medal of honor for city planning was awarded to George McAneny, president of the Regional Planning Association of New York and honorary chairman of the New York World's Fair Corp., at a dinner held in New York Dec. 4. About 150 architects and engineers were present. The award is the first to be made of a medal established by the Metropolitan Section, American Society of Civil Engineers, New York and Brooklyn chapters, American Institute of Architects and the New York chapter, American Society of Landscape Architects. It is to be awarded not more often than once a year "for distinguished contribution to the plan of the city of New York."

McAneny has been connected with the development of an organized plan for the city of New York for over 30 years. He is best known outside of the city for pioneering work in zoning and in height limitations for buildings. In 1916 he drafted the first comprehensive zoning law for New York, a law that served as the basis for all the zoning laws of this country.

Speakers at the dinner included representatives of the three professions, Frederick G. Frost, Ralph M. Rice, Hobart B. Upjohn, and Ralph T. Walker for the architects, Charles D. Lay for the landscape architects and Arthur S. Tuttle for the engineers. Tuttle paid tribute to McAneny for his understanding of engineering problems. McAneny, in his acknowledgment of the award, cited both architects and engineers as the creators who give reality to the planners' dreams.

Photos by Chicago Architectural Photographing Co.

LARGE COFFERDAM UNWATERED FOR CHICAGO FILTRATION PLANT

DEWATERING of the 38-acre cofferdam within which will be built the South District Filtration Plant for Chicago started Nov. 15 and was completed Nov. 22, some 172 mg of water having been removed. As noted in *ENR* Nov. 23, p. 682, the bulkhead is a clay corewall with a single line of interlocking steel sheet piling driven through the center to bedrock. The bulkhead is remarkably tight one 6-in. pump operating 5 min. per hour keeps the water down and most of this drains from pockets by means of trenches. No pumping was done on Sunday, Nov. 19, and during the entire 24 hr. no seepage was discovered, the stage remaining the same on starting up as when the pumps were shut down at midnight Saturday night. Pumping was done by three 16-in. electrically-driven centrifugal pumps having a rated capacity of 7,500 gpm against a 36-ft. head. The final stage of dewatering was done by three 6-in. pumps.

The lower view shows the south corferdam wall that slumped during excavating operations. City engineers say some slumping was expected, and pointed out that no leakage resulted therefrom.

The filter plant is being constructed under the direction of Loran D. Gayton, city engineer.

George Schlesinger Dies; Paving Brick Engineer

George F. Schlesinger, 54, chief engineer and secretary of the National Paving Brick Association, Washington, D. C., died in that city Dec. 1. Schlesinger graduated from Ohio State University with a civil engineering degree in 1907. Following six years of practice, he joined the engineering faculty of Ohio State University.

Harris & Ewing

George F. Schlesinger

During the World War he served as an engineer on construction projects at the Columbus Reserve Depot, and in 1919 became division engineer to the chief engineer of the Ohio State Highway Department. He became director of the department and public works head in 1925, resigning from this position, in 1928 to join the National Paving Brick Association. He was an active leader in highway and construction matters throughout his whole career. A member of many organizations he was awarded the Wellington Prize by the American Society of Civil Engineers in 1931.

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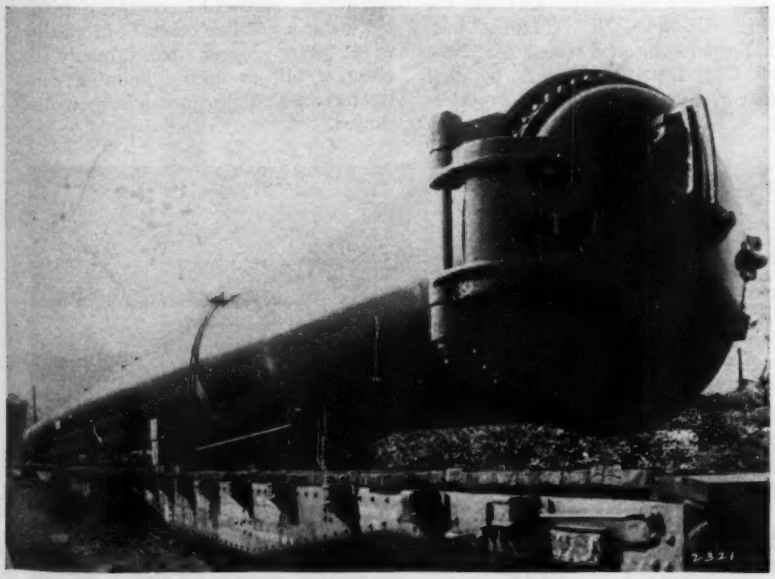
Texas Road Patroled To Stop Gopher Damage

Gophers have been doing so much damage to the concrete roadway of State Highway 31 between Malakoff, Tex. and the Trinity River that the Texas state highway maintenance forces have been forced to patrol the highway. In places the slab has been undermined until it was in danger of breaking with heavy traffic. Poisoned grain is being used to get rid of the pests.



TANK FOR TREATING PILES AND OTHER LONG TIMBER

THIS ALL-WELDED steel cylinder, 160 ft. long and 6 ft. 1 in. in diameter with a shell thickness of ⅝ in., is a creosoting cylinder built by the Treadwell Construction Co., Midland, Pa., for the Republic Creosoting Co. of Indianapolis, Ind. The cylinder is believed to be the longest all-welded unfired pressure vessel ever manufactured in this country and was built in ten days with a special welding procedure.

When in place a Joppa, Ill., plant, the cylinder will be anchored in the middle and supported longitudinally by saddles equipped with rollers, the rollers to allow free expansion and contraction of the tank with changes in temperature. The cylinder, which weighs 55 tons, was moved on four railroad flat cars each 40 ft. in length, and speed of shipment was restricted to 25 miles per hour.

Navy Design Work Let to Outsiders

Private engineer and architects employed to familiarize them with government methods

In a deliberate effort to acquaint the country's engineers and architects with its construction requirements, the Bureau of Yards and Docks of the U. S. Navy has employed a number of firms to do design work in connection with the $63,000,000 air base expansion program.

The design contracts are being let by negotiation, on the usual fee basis. Congress authorized fees up to 6 per cent, but contracts are being let at fees of 3 to 4½ per cent. Largest single contract has gone to Albert Kahn of Detroit who is doing some of the design in connection with all the bases outside the United States. Robert Co. of Atlanta is doing work in connection with the Jacksonville and Pensacola bases, and other firms designing Navy public works include Paul Cret and Lockwood Greene Engineers.

Rapid progress is being made on getting the Navy's bases under construction. All the bases outside the continental United States are already under contract, and comparatively small preliminary contracts for dredging and filling are now being let on the continental bases.

Three firms joined together to handle the Pacific bases, which were let in one contract estimated at $14,607,000. These were Hawaiian Dredging Co., Raymond Concrete Pile Co., and Turner Construction Co. The work covers a $5,714,500 base at Kaneohe Bay, Oahu; a $2,633,000 base at Pearl Harbor; a $3,720,000 base at Midway; a $1,030,000 base at Johnston; and a $1,510,000 base at Palmyra Island.

Two Alaskan bases, one at Kodiak and one at Sitka, are being built by a combination of Siems Spokane Co., Johnson Drake & Piper, and Puget Sound Bridge and Dredging Co.

A contract for an estimated $8,330,000 for construction of the San Juan, Puerto Rico, base was awarded last month to Arundel Corp. and Consolidated Engineering.

Largest of the bases in the United States is to be built at Jacksonville, Fla., at a cost of $15,238,000; an estimated $1,940,000 will be spent on providing docks at the nearby Banana River. About $5,770,000 will be spent on the Pensacola, Fla., base, and a base at Tongue Point Oregon will cost $1,478,000. Work costing $1,000,000 and $500,000, respectively, is to be done at Quonset Point, R. I., and Norfolk, Va.

OBITUARY

WILMER O. WHITESCARVER, 82, civil engineer of Columbia, S. C., died in that city recently. Following graduation from the University of Virginia with a civil engineering degree, Whitescarver served for a time as instructor at Georgetown College, the University of North Carolina and Hollins College. He once served as city engineer at Basic City, Va., worked for a time with the Georgia Central R. R., and was employed for 28 years by the U. S. Engineers.

OSCAR H. SHEFFIELD, associated with the Georgia state highway department for 20 years, died Nov. 25 in Atlanta. Sheffield, a graduate of the University of Georgia, taught at the University of Georgia before becoming associated with the state highway department.

RAYMOND A. SPENCER, 54, associated with the Canadian Bridge Co. for 27 years, died in Windsor, Ont., Nov. 26. At the time of his death Spencer was assistant general manager of the company. He was a graduate of the University of Vermont.

ARTHUR M. KINSMAN, 85, former chief engineer of the Baltimore & Ohio R. R., died Nov. 28 in Baltimore, Md. Kinsman received his engineering education at the Worcester Institute of Technology and joined the B. & O. in 1899 as engineer of construction of the lines west of the Ohio River.

RALPH H. CADY, 46, civil engineer associated with the Frederick Snare Corp., New York City, died recently in Tenafly, N. J. Cady was a graduate of the University of Michigan and spent several years on the design and construction of steamship terminals in the United States and Latin America.

AIKEN SIMONS, 59, retired civil engineer of Charleston, S. C., died recently in Florence, S. C. Simons retired five years ago on account of ill health after a long association with the DuPont industries.

OSCAR D. NEUMANN, 48, secretary-treasurer of Arthur H. Neumann & Bros., contractors, died Nov. 28 in Des Moines. Neumann attended Iowa State College and had been associated with his brothers in construction work in Iowa for the past 25 years.

GUSTAVUS A. SCHURY, 79, associated with the late Anthony C. Douglas on construction of the first power plant on the Upper Niagara River, died in Niagara Falls, N. Y., Nov. 28. He also worked on the aqueduct water supply system for New York City.

HARRY R. ALLENSWORTH, since 1930 consulting engineer for the city of Cleveland, died in Columbus on Nov. 30. He was the first consulting engineer ever to be hired by the city of Columbus and in 1930 went to Cleveland.

ALFRED HOYT GRANGER, who founded Frost and Granger in 1898, Chicago, died Dec. 3 in Roxbury, Conn. He was a graduate of Massachusetts Institute of Technology.

Other recent deaths include: STUART A. BRISCOE, division engineer of the Mississippi State Highway Department, Brookhaven, Miss.; FERNAND ROBERT, civil engineer, formerly employed by the Bell Telephone Co. of Canada, Quebec City, Que.; FRANK S. DAWLESS, 75, retired contractor and builder, Stamford, Conn.; H. LAWSON OLIVER, JR., 42, civil engineer of Georgetown, S. C., Georgetown; GEORGE MIDDLETON, 31, civil engineer of Miami, Okla., Choteau, Okla.; ANDREW LEITCH, road building contractor, Underwood, Minn.; PEDRO FUENTES BARRAGAN, 51, civil engineer and chief of the conservation department of the Mexican National Highways Commission for several years, Mexico City; MARSHALL KRAMER, 65, builder, Rochelle, Ill.; CHARLES LERNER, retired builder of Miami, Fla., New York City; DAVID W. BURPEE, 64, civil engineer, New Brunswick, at Fredericton, N. B.

Further Research Planned In Structural Welding

Formation of a new structural welding research committee to continue the work carried on by an earlier committee dissolved a year ago was discussed at a conference of interested men and organizations held under the auspices of the American Welding Society at New York on Nov. 29. The conference actively favored prosecution of further research work and outlined numerous problems remaining to be solved in connection with structural behavior and stress distribution in welded bridges, buildings and other structures.

Further steps to establish and finance such a research committee are in progress. If set up the committee would be organized under the auspices of the Welding Research Committee of Engineering Foundation (A. Adams, chairman) in cooperation with the American Institute of Steel Construction, the American Welding Society, and others.

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British Columbia Builders Not to Be Licensed

Due to war conditions and the resulting unwillingness of the British Columbia government to support any legislation restricting competition or hinting at a possible control of industry to a larger degree than already in effect, a bill to license building contractors in that province has been discarded.

Acme Photo

BRIDGE WRECKED WHEN TRUCK COLLIDES WITH TRUSS

LAST WEEK a bridge 5 mi. south of Yellow Springs, Ohio, on State Route 68 was wrecked when a truck collided with one of the members of one of the trusses. The driver, only occupant of the truck, escaped uninjured.

Hydraulic Fill Work Complete for Sardis Dam

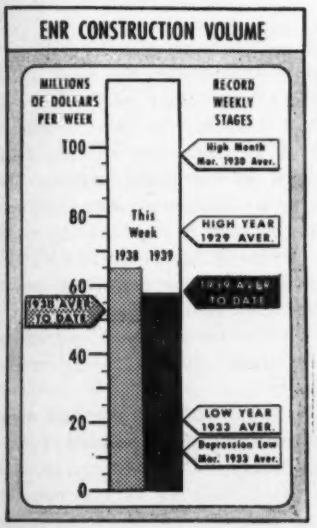
The hydraulic fill work for the main portion of Sardis Dam, a flood control project on the Tallahassee River near Sardis, Miss., has been completed, according to the U. S. Engineers. The work was done by government forces with the dredge Pontotoc and hired labor, completion being one month ahead of the predetermined schedule.

The top of the dam has been raised to El. 312, mean Gulf level, and the dam and abutments dikes are approximately 14,500 ft. long, with a maximum height above stream bed of 117 ft. The total fill was 16,800,000 cu.yd., of which 13,900,000 cu.yd. was placed by the hydraulic method, the remainder by rolled fill method. Contract forces did the rolled fill work.

CONTRACTS AND CAPITAL

ENGINEERING construction awards for the week total $57,739,000, an increase of 0.4 per cent over last week, but 11 per cent below the volume for the corresponding week last year.

The construction total for 1939 to date, $2,870,268,000, is 11 per cent higher than in the 49-week period last year.



Private awards for the week drop 0.3 per cent under last week, but are 119 per cent above the volume for the 1938 week. This is the 13th consecutive week in which they have topped their respective 1938 values. Public construction is 0.8 per cent higher than a week ago, but 33 per cent below a year ago.

In the classified construction groups bridges, commercial building and large-scale private housing, and public buildings are above their respective totals of a week ago. Bridges, industrial buildings, commercial buildings, streets and roads, and unclassified construction top their totals of a year ago.

New capital for construction purposes for the week totals $27,110,000, a decrease of 64 per cent from the volume reported for the corresponding week last year. This week's new financing is made up of $14,164,000 in USHA loans for low-rent slum-clearance projects in 11 cities, $8,842,000 in state and municipal bonds, and $4,104,000 in corporate securities.

New construction financing for the year to date, $2,380,027,000, is 35 per cent lower than the $3,672,016,000 reported for the 1938, 49-week period.

(Weekly construction on page 51)

Economic Questions Arouse Arizona Engineers

Economic questions were the subject of active discussion at the annual meeting of the Arizona Section, American Society of Civil Engineers, held at Phoenix, Nov. 25. Following a discussion of society affairs by Charles T. Leeds, director, and A. M. Rawn of the society's committee on professional objectives, a heated discussion was precipitated by a demand from James Girand, city engineer of Phoenix, that the board of direction of the society make an honest statement of what if anything it proposed to do about the economic welfare of engineers. Girand stated that the society had consistently fought all other organizations such as the American Association of Engineers and the engineers' unions that had attempted to improve the economic welfare of engineers and presented a resolution calling upon the society to declare its policy, withdraw from welfare activities and support other organizations that take up such work. The resolution failed adoption but discussion of it resulted in a vote to call a special meeting within 30 days to discuss pay and related questions.

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No Collusive Bidding In Tennessee Road Work

When Charles D. Snead, district engineer of the PRA office at Montgomery, Ala., investigated the bidding on contracts for highway work being done by the Tennessee State highway department, he found no evidence of collusive bidding. The investigation was made after the governor of Tennessee complained that certain bonding firms were receiving favors from contractors.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY ENGINEERING NEWS-RECORD, IN NOVEMBER, 1939

Engineering News-Record *reports projects of the following minimum costs: — water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Five Weeks — Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States November 1939	United States Eleven Months 1939	United States Eleven Months 1938	Canada
Waterworks	616	1,192	218	4,633	1,315	2,454	10,428	157,914	100,375	2,753
Sewerage	588	4,910	530	3,184	1,677	237	11,126	152,065	111,054	167
Bridges, public	466	3,135	1,371	1,804	1,672	1,797	19,245	134,000	96,669	30
Earthwork and waterways	636	2,363	2,366	1,369	4,403	4,271	15,408	219,505	246,876	423
Streets and roads	1,965	20,057	8,504	7,776	19,485	6,352	64,139	598,658	587,719	183
Buildings, public	8,487	32,880	7,299	5,910	5,268	2,665	62,509	560,113	400,438	894
Unclassified, public	422	4,973	1,729	1,971	2,659	4,974	16,728	161,109	168,451	766
Total public	**13,180**	**69,510**	**22,017**	**26,647**	**36,479**	**22,750**	**190,583**	**1,983,364**	**1,711,582**	**5,216**
Federal government (included in above classifications)	3,880	8,881	5,505	1,499	4,024	11,068	34,857	331,541	328,395	.....
Private										
Bridges, private	.....	764	.....	.....	.....	.....	764	7,277	7,568	.....
Buildings, industrial	2,691	19,452	6,432	4,072	5,860	487	38,894	259,714	135,780	1,400
Buildings, commercial	7,009	20,552	6,554	8,404	2,004	1,410	45,933	353,101	528,291	479
Unclassified, private	872	8,640	4,360	3,420	5,989	2,760	26,041	205,073	79,460	425
Total private	**10,572**	**49,308**	**17,346**	**15,896**	**13,853**	**4,657**	**111,632**	**829,165**	**741,099**	**2,304**
Total Engineering Construction										
November, 1939 (5 weeks)	**23,752**	**118,818**	**39,363**	**42,543**	**50,332**	**27,407**	**302,215**	.....	.....	**7,520**
October, 1939 (4 weeks)	9,236	70,935	44,925	33,882	44,003	42,081	245,062	.....	.....	8,163
November, 1938 (4 weeks)	12,310	72,241	29,441	31,335	47,454	24,242	217,023	.....	.....	6,035
Eleven Months — 1939	158,747	924,244	414,965	513,402	507,403	293,768	.....	2,812,529	.....	107,354
Eleven Months — 1938	124,387	945,219	251,678	328,394	434,693	368,310	.....	.....	2,452,681	79,675

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Toll Roads and Bridges

Sir: I want to express my agreement with the splendid editorial, "Toll Road Study Needed," in the Oct. 26, 1939, issue. The position taken in that editorial is eminently fair, and is the type of editorial consideration that should be more widely given in this country to problems of the toll road and toll bridge industry. I agree thoroughly that if proper study is given to the problem of toll roads and toll bridges, there are many places where they will be found useful, and that their total elimination without careful study would be a very harmful procedure to the interest of the public.

If your suggestion is followed and the proper study is given to the problem, I am sure that there will be many cases where the toll roads and toll bridges will be found highly beneficial and useful. The history of the toll road in Connecticut shows that the public is willing to pay for a good facility and that they are not antagonistic to it when its feasibility is properly proved.

J. W. BERETTA
President, American Toll Bridge Association
San Antonio, Tex.

Building Wall Design

Sir: I wish to take exception to G. L. Bilderbeck's letter, "Thin Walls In Housing" in your issue of October 26 in the strongest terms.

Mr. Bilderbeck states in regard to the Queensbridge project that "while the engineering authority has been able to reduce the per room cost to a low figure, it has done this largely at the expense of good construction." He goes on to say: "The dead load unit-stress on this combination wall at the second floor level, assuming a reasonable increment for the partitions, is upwards of 500 lb. per sq. in., and at the first floor level is in excess of 700 lb. per sq. in. This takes into consideration only the dead load."

The facts of the matter are that all these walls were carefully designed, so that the live and dead load would not exceed the requirements of the New York building code which are 100 lb. per sq. in. for hollow block and 250 lb. for brick masonry. In the few cases where these unit stresses were slightly exceeded stronger material was submitted, for instance, brick for tile in the upper stories and reinforced concrete for brick in the lower stories.

Your correspondent's mention of 500 to 700 lb. per sq. in. pressures indicates an error in computation which looks suspiciously like a decimal point misplaced. That is, the load per running foot on the walls in the first story is roughly about 12,000 lb. which divided by 144 would give 80 lb. per sq. in. as against your correspondent's 700 lb.

The reference to wind pressures is somewhat confusing so I will merely let that matter rest with the statement that these buildings were carefully designed to resist wind pressure in accordance with the New York code.

These buildings are of four-hour fireproof construction, far more substantial than the usual six-story brick and frame apartment house common for structures of a much more expensive class.

Then how can one substantiate the statement that the results were obtained at the cost of good construction?

Unfortunately, printing lends an undue importance to such damaging though incorrect statements.

ELWIN E. SEELYE
Consulting Engineer, New York

Sir: Only the great pressure of work has prevented us from answering sooner G. L. Bilderbeck's letter to you on thin walls in Queensbridge Housing job, which was printed in your issue of October 26th, 1939.

We do not have the faintest idea how Mr. Bilderbeck arrived at a 700-lb. per sq. in. dead load unit-stress at the first floor level. If he had taken the trouble to extend this out he would have arrived at the amazing figure of a 50-ton load per sq. ft. We certainly hope that there is some mistake in Mr. Bilderbeck's calculation as our piles, which are spaced a great deal farther than 12 in. on centers, are only good for 30 tons. According to our calculations, the total live and dead load at the bottom of the wall at the first floor is less than 80 lb. per sq. in. for an average span of 15 ft.

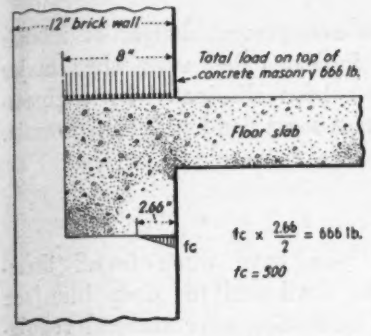
So far as danger of these buildings being destroyed by hurricane, if we are wrong here, then at least 50 per cent of the buildings in New York City, which are wall bearing structures, are wrong too. We must confess that we have not gone into the "bursting pressure in rooms that may be closed caused by a sudden drop in the barometer," but from the writer's thirty years' experience on construction work in and around New York, we do not believe that there is any likelihood of these buildings bursting from that cause.

ALLAN S. HARRISON
Secretary, New York City Housing Authority

Sir: We were not intending to criticize unfavorably the work of Mr. Seelye or any other particular engineer, but rather to take to task a method of procedure that is being accepted by the engineering profession as a regular practice and permitted by some of the building codes. The Queensbridge project is built in essentially the same manner as nearly all the large housing projects, not to mention the thousands of apartments and business buildings being erected annually.

It is suggested that the unit stress in these walls at the second floor is more nearly 50 lb. per sq. in. than the 500 lb. stated in my previous letter. This might be true if the loads transmitted to the walls were axial, which of course is not the case in buildings of this type because, when the floor slab deflects upon removal of the forms, the reaction on the wall is concentrated along the inner edge.

We have computed that the weight of masonry, etc., at the second floor level would amount to 1,000 lb. per lineal inch of wall, so that, as shown in the accompanying sketch, the wall dead-load transmitted through the slab to the wall below would be 666 lb. This would be concentrated in a triangular stress distribution at the inner face of the wall. Assuming the base of this triangle to be between 2 and 3 in., say 2.66 in., the unit stress would be 500 lb. per sq. in.



Typical wall and floor slab detail illustrating theory of high concentration of stress at inner edge of wall.

As stated, our letter was not written with any thought that this design had been improperly done by Mr. Seelye, because we assumed that he had conformed to the building code requirements in every respect. It was more to point out the fact that the building code as drawn permits unsatisfactory construction.

G. L. BILDERBECK
Civil Engineer,
New London, Conn.

[EDITOR'S NOTE—In answer to Mr. Bilderbeck's above explanation Mr. Seelye states, "This assumes that the eccentric loading due to floors is cumulative. As a matter of fact, floor slab deflection produces a moment in the wall at each floor, and *the effects of these moments are not cumulative.* Assuming a negative moment in the floor slab of $wl/24$, according to the American Concrete Institute code, an excess unit stress of 25 lb. per sq. in. in the brickwork might be generated, bringing up the total unit stress in the first story to $80 + 25 = 105$ lb. as against the 700 suggested."

It seems clear that Mr. Bilderbeck, in choosing in his original letter to use a particular building as an example to illustrate an abstract point with respect to building codes in general, gave an erroneous, and as he states unintentional, impression concerning the design of the Queensbridge housing project, which design is in fact in strict accordance with the best current practice.]

Not an Exact Solution

Sir: Referring to the article, "Three Point Problem Simplified" (*ENR*, Oct. 12, p. 488), it is indeed refreshing, after the years of use of the three-point location in plane-table surveying and the many analyses of the problem which have been made, to learn that an "exact" solution in the field is such a simple matter. However, a fallacy which the writers seem to have overlooked makes the solution not so nearly exact as it appears at first glance. The lines joining the homologous angles of the two similar triangles of error can meet in a common point only if the homologous sides are parallel, which, by the conditions of their construction, they are not. If the solution were correct it would follow that the locus of the intersection of lines drawn from any two points on the ground through their plotted positions on the plane table sheet would, for any orientation of the board, be a straight line. This is not true. Assuming the known points to be sufficiently remote so that the angle of intersection is practically constant for all lines drawn from them to the table, the locus of the points of intersection of lines drawn through any two points on the ground and their plotted counterparts on the board is the perimeter of a circle passing through the plotted positions. Three such circles, passed through respective pairs of plotted points used in the three point location and the corresponding angles of the triangle of error, will intersect in a common point which is the true point sought in the problem. There is nothing new about this solution. It is geometrically simple but so cumbersome for field use that expert topographers prefer the "cut and try" method.

It is the opinion of the writer that if the solution described in the article were of practical value it would have been in general use for many years.

SHELDON K. BAKER
Consulting Engineer
Phoenix, Ariz.

Famous Engineers

Sir: I read with interest the article entitled "Why So Few Famous Engineers Today?" by Farley Gannett in your issue of Aug. 17, p. 226. It seems to me that Mr. Gannett is mistaken in his assumption that there are only a few famous engineers at the present time. We have more outstanding engineers today than in the past.

What is meant by the designation "Famous Engineers"? Obviously engineers of fame are men of intelligence, wide experience, good judgment and social vision.

There is not sufficient space to give more than a few examples of famous engineers of today who are outstanding in our profession. Mr. Gannett has listed a limited number and I will give some additions. Let us begin with Daniel W. Mead; he ranks at the top and has a long record of independent service for the public welfare. In addition I suggest the names of O. H. Ammann, Ole Singstad, James Forgie, Shortridge Hardesty, David B. Steinman, E. R. Needles, George E. Beggs, George W. Burpee, W. W. Colpitts, W. H. Coverdale, George S. Davison, W. J. Wilgus, Gavin Hadden, Fred Lavis, Frank Masters, Malcolm Pirnie, Carlton Proctor, Henry Earle Riggs, Gano Dunn, Dugald C. Jackson—but hold, the list is so long that I must stop!

Times have changed and engineers have adapted themselves to new conditions. There are many famous engineers connected with corporations, but I am limiting my suggestions to engineers in private practice. Under present conditions engineers should and do understand engineering, accounting, economics, legal procedure and social welfare. Never before in the history of the world has the public required engineers to solve such intricate problems which affect the destinies of our country. It can be said with confidence that there are today a large number of famous engineers.

EDWIN F. WENDT
Consulting Engineer
Pittsburgh, Pa.

Unsigned Letters

Occasionally letters are sent to this journal for publication that are signed only with initials or with a pen name. It is contrary to sound policy to publish such letters unless the identity of the author is made known to the editors. If for some good reason readers of the journal wish to make comment on articles or current matters of interest without revealing their identity to the public, such communications should be sent to the editor with a carrying letter signed by the person sending the letter and setting forth his reasons for wishing to publish the communication without revealing his identity. Each communication so received will receive every consideration—EDITORS.

ENGINEERING NEWS-RECORD

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Editorial Offices at 330 West 42nd Street, New York

DECEMBER 7, 1939

CONSTRUCTION LABOR is organized almost exclusively on a craft basis, each trade independent of others except in so far as local labor councils bring them together in joint action. Now the establishment of a building industry union in the District of Columbia area and the attempt to organize on the same basis in New York City holds out a challenge to the established system. What may develop from the new movement is hard to foretell, since the craft system is unlikely to yield without a strenuous fight. For clear perspective it should be kept in mind that industry or job organization is already practiced to some extent, as in compressed-air work, and on some individual jobs where labor itself recognized that the craft differentiation was inefficient. But a like conclusion applies to the organizational set-up of many other construction jobs, where the craft system stands in the way of coordination and progress and is against the interests of the worker himself. Such conditions plainly favor the growth of an industry-union system. Whether they can and will be worked out by the craft unions themselves or whether a competing system is required to bring action remains to be seen.

Unexpected Dangers

AMONG THE SURPRISES that mark the history of floods the lower Colorado flood of early September takes a prominent place. Construction of Boulder Dam was believed to have freed the lower valley from danger of floods except those that might come from the uncontrolled Gila; but the damage done by the abnormal rains of Sept. 4-13 shows this belief to be too optimistic. Bad breaks in the canal systems of both the Imperial and Yuma projects constituted part of this damage and on the Yuma project threatened a grave water famine which was only averted by bringing water in through the new All-American Canal. The account of the flood effects given on p. 71 reemphasizes strongly the ever-present danger of intense local floods and indicates that even when major flood hazards have been eliminated by engineering works important local flood problems remain.

What to Do?

CONTRACTORS who have often found themselves between the devil and the deep blue sea on the matter of conflicting governmental regulations will sympathize with those of their colleagues who plan to bid on a federal building job in Des Moines. Specifications state the bids shall not include any state sales tax on materials and supplies. Contractors are informed upon inquiry to the state tax authorities that the tax most certainly will be collected. Perhaps the Des Moines bids won't include the cost of sales taxes, but we'll bet they include, as indeed they should, some unbalanced item to cover the expense.

Progress in Welding

LARGE-SCALE APPLICATION of structural welding of unusual kind, represented in the welded steel lining used in the Manhattan land section of the new Queens-Midtown Tunnel and by the welded saddles of the Tacoma Bridge (p. 91 of this issue), pictures the progress that is being made in the art by practical courage combined with skill and competence. These two works prove that enough is known about practical welding problems to open the way for wider use of structural welding. On the other hand, there are still many points that need to be explored further, and in recognition of this fact steps are now being taken to organize a new structural welding research committee, as discussed last week at a conference under the sponsorship of the American Welding Society. With a purposeful program, this committee cannot fail to hasten the extension of welding to the full scope of its possibilities.

Welded Cable Saddles

WELDING has been used so widely in the structural field that new applications do not excite the attention they once did. Yet the fabrication of large suspension bridge cable saddles recaptures some of the spectacular qualities that were associated with the early developments in structural welding. As cable saddles have always been the particular province of steel castings, the welded saddles of the Tacoma Narrows Bridge are par-

ticularly significant, and the reasons for their use are important. In the main these reasons are the same that have made welded rocker shoes and expansion dams on bridges competitive with castings—reduced weight, elimination of pattern costs, simplicity of design and the retention by the steel fabricator of business that otherwise would be sublet to a foundry. That a design and a welding plan for the thick plates here required were devised that produced a true and sturdy saddle is evidence of the high state to which the welding art has been developed.

Safe Traffic on Safe Roads

GRATIFYING FIGURES of safe traffic operation on Golden Gate Bridge are reported briefly on another page. They demonstrate what can be accomplished toward reduction of highway traffic accidents. This particular good record was made on a fully lane-marked roadway so laid out as to be substantially free from danger points. While the traffic was relatively light, it was not much lighter than that on some trunk roads whose safety record is distinctly bad. The figures support the widely held view that the construction of the roadway itself is responsible for many accidents, and that road designers share with operating and supervisory authorities the responsibility for cutting the accident toll.

Not So Complicated

A DOZEN YEARS AGO the design of a continuous truss bridge was considered so difficult that few of them were built. Design has now been so well mastered that it is reduced to a routine. In the past, great concern was felt over the possibility of uneven settlement of the foundations under continuous trusses, and reactions were carefully weighed and adjusted to make them conform with calculations. Today, continuous trusses founded on piles reflect the attitude toward settlement and it is seldom that any great refinement in shoe adjustment is considered necessary. In this issue, an article describes how a long continuous truss bridge was raised 17 ft. with no more difficulty and little more care than for a simple span. The engineers found that a variation of the end supports with relation to intermediate supports of as much as 7 in. either up or down from normal position caused no overstressing of the truss members. This confirms what was first concretely recognized by the engineers of the Sciotoville and Bessemer bridges, namely that continuous trusses are not such complicated structures as theoretical calculations formerly led us to believe.

St. Lawrence Power

DEVELOPMENT of the power resources of the international section of the St. Lawrence River appears to be much nearer than seemed possible when the United States in June of last year asked Canada to join in a new power and navigation treaty. Canada then had what appeared to be ample power resources and was little interested in the long-discussed deep waterway, chiefly because of its ownership of one of the two railroad systems with which the waterway would compete. But now the war has made a radical change in the situation.

Power demand for war industries added to the substantial normal growth of power demand in Ontario, Canada's major industrial province, has set the Ontario Hydro-Electric Power Commission to looking for additional sources of large quantities of power. In that search the St. Lawrence stands out as the most available source, hence the Premier of Ontario has withdrawn his opposition to federal participation in development of this international stream.

Obviously, St. Lawrence power can be of no value in meeting war needs unless the war lasts much longer than anyone now is willing to believe, but it is probable that the war will last long enough to serve as the justification for an international treaty that will lay the groundwork for development of the river. What form the groundwork will take therefore becomes of special interest. Waterway proponents may be expected to advocate an immediate start on the ship canal, but it is to be hoped that the treaty drafters will turn a deaf ear to their importunities.

There was no economic justification for the ship canal when it was first proposed; there is much less today. Therefore, sites for the dams should be so chosen as to give power needs first preference. Those across the present navigable channel should be equipped with locks that can be altered for deep draft navigation at a later date and others should be designed for the addition of locks. The dams should be built only as power needs make them necessary. This will cut the power costs and will postpone decision as to the ship canal until a day when trends in export, especially in grain movements, can be better evaluated than they can today.

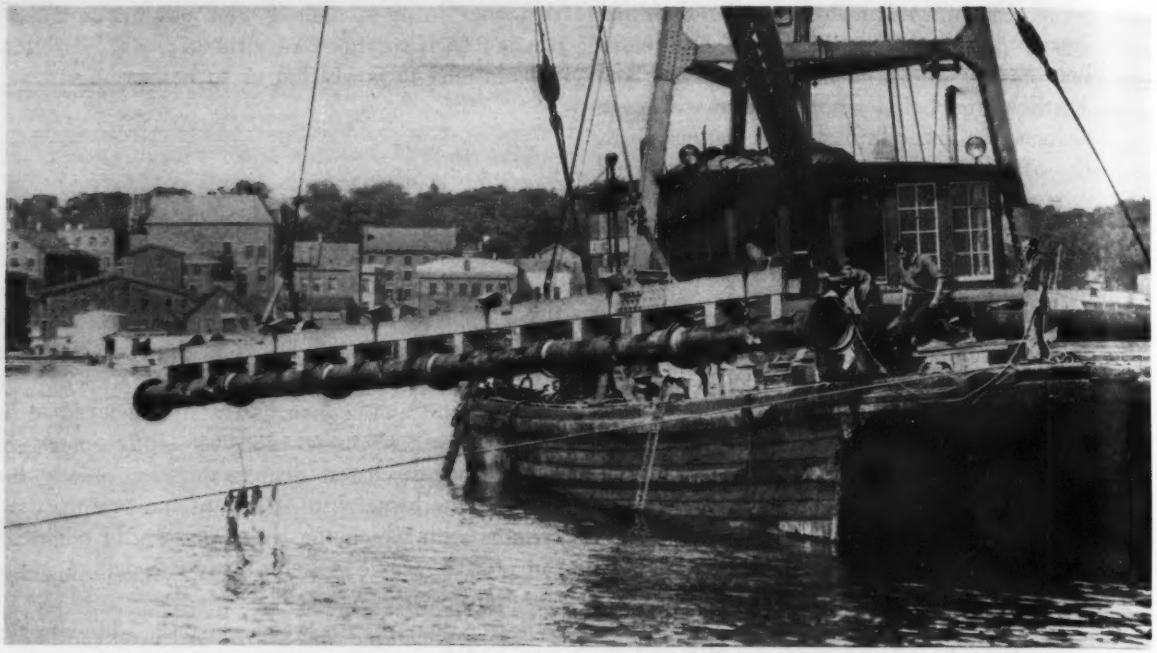


FIG. 1. STRONGBACK LOWERING A SECTION OF THE MAIN WHICH WAS COUPLED UNDER WATER.

Difficult Underwater Pipelaying

E. B. MYOTT

Senior Engineer, Ray, Spofford & Thorndike, Boston, Mass.

Contents in Brief—Laying a 16-in. water main under the Kennebec River at Bath, Maine, involved construction operations in deep water over an irregular channel bottom with steep banks. Special pipe anchorages were employed and a new type of flexible joint was used.

ONE OF THE MOST DIFFICULT submarine pipe crossing jobs ever undertaken has been completed at Bath, Maine, where a 16-in. water line has been laid across the Kennebec River. Deep water over an irregular channel, steep river banks and rapidly changing tidal currents called for special precautions in pipe design and pipe anchorage.

This crossing is the fourth installation made over a period of nearly half a century to maintain a connection between the lake supply on the east side of the river and the distribution system in Bath. The first pipelines built across the river in 1894 and 1895 were laid upon the bed of the river without any pile foundations. Both were complete failures. The third pipeline built in 1900 was laid on pile bents and while it is still usable it is not in good condition. A number of breaks have occurred due to failure of joints and damage resulting from boats dragging anchors. In an attempt to repair a serious leak last winter the main was badly damaged by dragging anchors on the floating equipment. The cost of this repair, including charges for temporary water supply facilities, was about $35,000.

In front of the city the river is about one-half mile in width and has a maximum depth of around 50 ft. at mean low water. Tidal currents at this point range up to 8 mph. The river bed, principally of fine sand, shifts considerably, at times to a maximum variation in elevation of about 10 ft. The west bank of the river is ledge rock and the surface is quite irregular.

The new 16-in. water main is 2,670 ft. in length, of which 2,444 ft. is underwater. About 2,200 ft. of the underwater section is carried on pile bents, the remainder resting on ledge rock. The plan and profile are shown in Fig. 2. The pipe joined above water has flexible joints of the Metropolitan type and the pipe joined under water has Usiflex joints. These are illustrated in Fig. 3.

The Metropolitan joints conform to standard dimensions except the widths of the machined surfaces of the bell-and-spigot bearings was increased from $\frac{1}{2}$ in. to $1\frac{1}{2}$ in., and a tolerance in the width of the annular space at the hub of the bells was limited to $\frac{1}{16}$ in. All pipe is of standard lengths of 12 ft. except in a few instances where Usiflex pipe in lengths of 6 ft. is used.

The Usiflex pipe, designed by Edward Hering, chief engineer of the United States Pipe and Foundry Co., is a recent development and the Bath job marks its initial use. Instead of

using a lead joint as in the Metropolitan type pipe, the joint is made of a rubber gasket, a split ring and a follower ring which is bolted to a flange provided on the bell of the pipe. The spigot bell end of this pipe is of the same dimensions as those of the Metropolitan type. The combined use of these two types provided flexibility and strength in the joints and simplified installation.

Construction equipment

In order to keep the number of joints made underwater to a minimum, the water main between the river banks was laid in sections of not less than six pipes. This requirement and the rapid current in the river made necessary the use of a large lighter for laying the pipe. A smaller lighter was used for the piledriver rig, which lighter was also used for excavation.

The lighter for pipe laying was equipped with an 82-ft. boom and it could lift up to 25 tons. Equipment included a 60-hp. steam boiler; a 10x14-in. 6-drum engine; a steam-driven air compressor; a 1½-cu.yd. clamshell bucket; two 2-drum hoisting engines for operating mooring cables; four 3½-ton anchors with four 800-ft. lengths of 1-in. wire rope; and four 2½-ton anchors with manila lines.

The piledriving equipment consisted of a 12x24-in. H-beam 64 ft. long which was used as a spud for guiding the pile hammer. It was held in position by the lighter boom and guys. Each hammer had ¾x3⅜x4⅛-in. Z-bars welded and bolted to one side

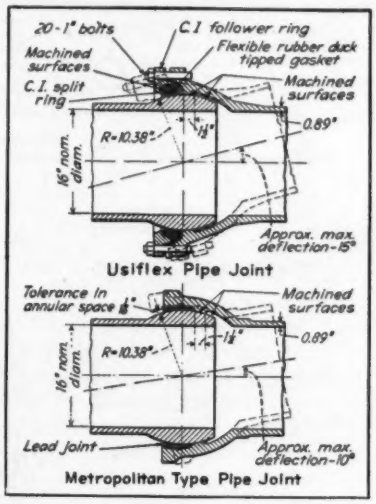


Fig. 3. Types of joints used on the 16-in. underwater main.

to guide it along the flange of the spud beam. A semicircular pile clamp with Z-bar guides for following the flange of the H spud beam and loose chains spiked to the pile about 15 ft. below the butt were used to keep the pile in a vertical position at the beginning of the driving operation. As the pile was driven, the increased size of the pile caused the spikes to be pulled from the pile. The clamp being suspended from the hammer by wire rope was pulled to the surface with the hammer.

Construction operations

Untreated Norway or red pine piles in lengths of 30 and 40 ft. were used for the bents. They had a diameter 3 ft. from the butt of not less than 14 in. and a tip diameter of not less than 8 in. A minimum penetration of about 25 ft. in sand was deemed necessary. Piles could only be driven at slack water as it was impracticable to handle the piles and the pile spud when the tide was running.

Two divers were used in cutting off piles. One diver would fasten battens on each side of the two piles in a bent and the other diver would saw the piles off along the top of the battens, using a 4-ft. hand saw. An average of four to five piles were cut off per day. Work on the piles and pipe laying was done only at slack water at the two tide changes per day. Diving time per tide varied from 1¼ to 2½ hours and averaged 1½ hours throughout the job.

One diver would place six caps in one tide including the driving of the drift bolts but not including the installation of the pile straps. Later this diver did all work in connection with laying the pipe, including the installation of the U-straps and wedge blocks, generally installing six U-straps per tide. The caps were bored for the drift bolts and pile straps on the deck of the lighter. An air drill was used to bore the caps under water for the U-straps and the piles for the lag screws used for fastening the pile straps to the piles.

Pipe laying

After the caps had been drift-bolted to the piles, a section of pipe was laid. Six lengths of pipe were joined together on the deck of the lighter and the Metropolitan joints were poured and caulked. Then the cast

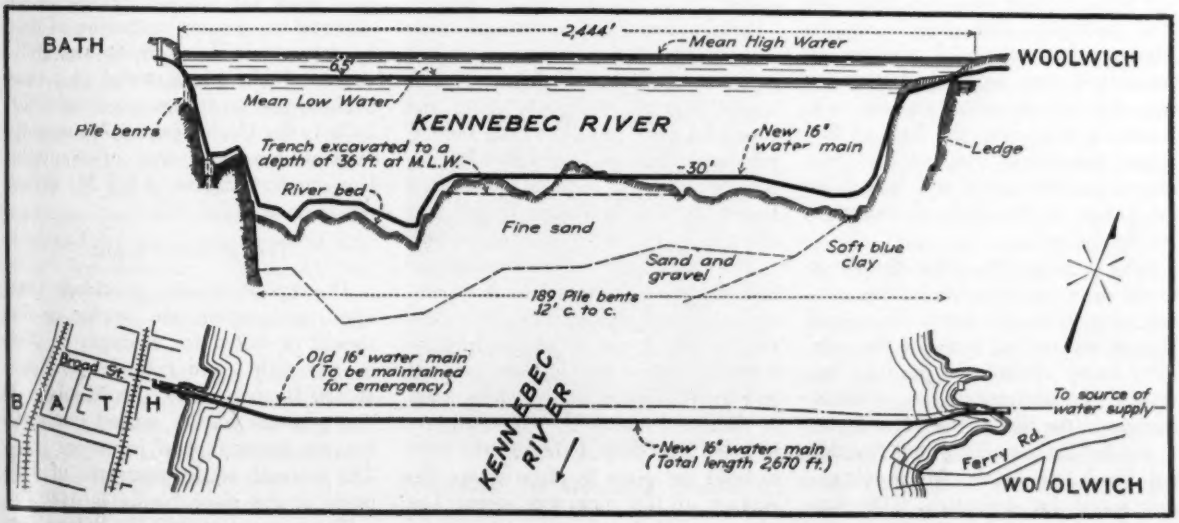


Fig. 2. Deep water and steep banks characterize the route of the submarine crossing at Bath, Maine.

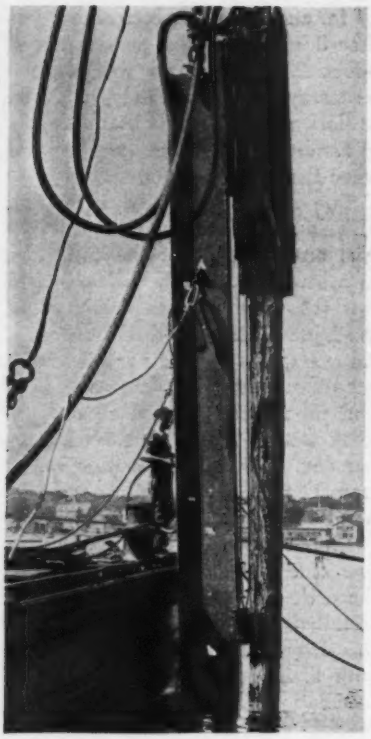


Fig. 4. Piledriver with an H-beam guide to keep it in position over the pile.

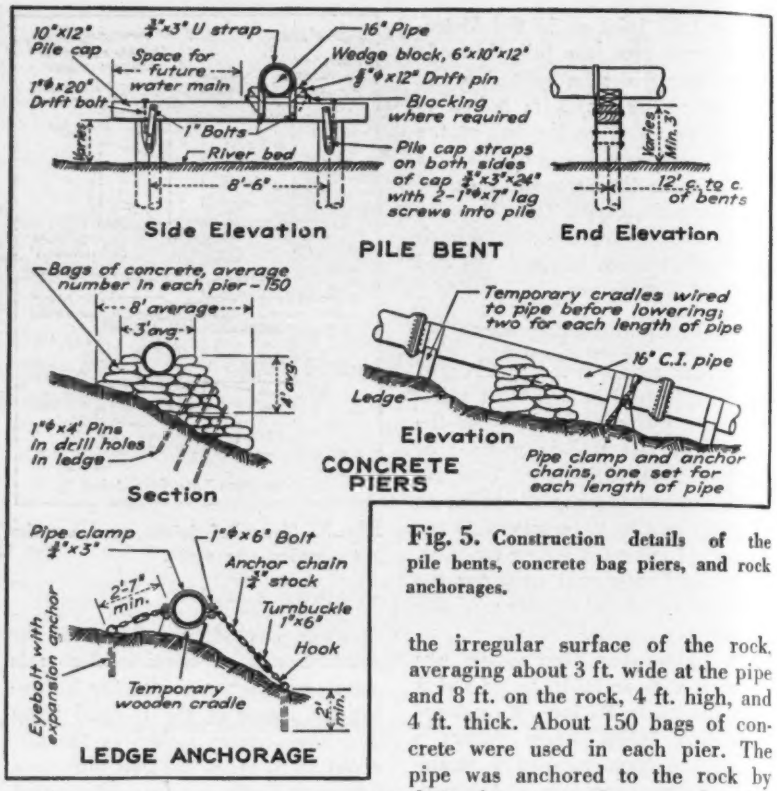


Fig. 5. Construction details of the pile bents, concrete bag piers, and rock anchorages.

poured and caulked. Then the cast iron follower ring, the cast iron split barrel of the pipe back of the spigot Usiflex joint were installed on the ring and the rubber gasket for the ball. The wedge blocks with the drift pins driven partly into them were fastened to the strongbox.

As the section of pipe was lowered into place, it would be guided by one driver until the spigot had been inserted into the bell where it was held in place until the joint has been made up. This was a simple job requiring about 15 minutes of the diver's time as he had only to slide the rubber gasket and the cast iron split ring over the ball of the spigot, then move the cast iron follower ring into place and bolt it to the flange of the bell of the pipe previously laid.

After making the joint the diver would line up accurately the section of pipe on the bents. Occasionally on account of some of the pile bents being slightly off line or because of horizontal or vertical changes in the line of the water main, it would be necessary to "break" and bend one of the Metropolitan-type joints for deflection. This was done by the use of a line from the lighter and required a considerable pull. Following the alignment, a diver installed blocking and then the wedge blocks and the U-straps. Six straps were generally installed per tide.

Anchoring pipe to ledge

On the west bank of the river the main was laid on ledge, and this called for a secure anchorage. The main was laid in sections of different lengths varying from two to six pipes.

Before the pipe was placed, temporary wooden blocking was fastened to the pipe so that no metal would bear on the rock. After the pipe had been jointed to the section previously laid and securely blocked, concrete piers were built under each length of pipe and each length was chained to the rock (Fig. 5).

The piers were built of an assembly of burlap bags of 1-cu.ft. capacity half filled with dry concrete consisting of 1 part of high-early-strength cement and 3½ parts of sand and gravel. Wrought iron pins 1 in. in diameter and 4 ft. long were set in holes 2 ft. deep drilled in the rock to hold the piers in place where the surface of the rock was steep. The piers varied in size on account of the irregular surface of the rock, averaging about 3 ft. wide at the pipe and 8 ft. on the rock, 4 ft. high, and 4 ft. thick. About 150 bags of concrete were used in each pier. The pipe was anchored to the rock by chains between a clamp on the pipe and eyebolts set into the rock. The chains were provided with turnbuckles.

Careful consideration was given to different kinds of metal for pipe bolts and miscellaneous hardware for fastening the pile caps to the piles and the pipe to the pile bents. As a result it was decided to use Ihrigize steel for all bolts and miscellaneous hardware. Ihrigize steel is any standard steel with a low sulphur content so impregnated with a silicon alloy after fabrication that the piece of metal has a complete casing of this harder metal. However, it was difficult to obtain this material at a reasonable cost so it was used only for bolts in the Usiflex joints. All miscellaneous hardware was of wrought iron conforming to A.S.T.M. serial designation A207-38T.

Test of water main

The specifications provided that after completion the water main should be tested for strength at 250 lb. per sq.in., and then for leakage at 150 lb. per sq.in., the leakage at this pressure not to exceed one gallon per linear foot of joint per day. The normal static pressure of the main at the river banks is 100 lb.

The leakage at 150 lb. before the

main was tested for strength at 250 lb. was at the rate of 1.20 gal. per ft. of joint per day and the leakage at 150 lb. after the strength test had been made was at the rate of 0.73 gal. per ft., considerably below the specified requirement. The tests indicated apparently that after the test pressure for strength had been applied, the Metropolitan joints had tightened; it is assumed that the Usiflex joints are absolutely tight. These tests also show definitely that the water main is securely anchored and that the types of joints used are particularly suitable for this type of work.

Cost of project

The cost of the installation, including engineering, legal and administrative expenses, and interest during construction was $137,000, or about $50 per lin. ft. of main. With the exception of some preliminary work, the job was completed in six months beginning in April of this year.

Labor costs of some of the principal items of work, exclusive of contractor's insurance, overhead and profit, were as follows:

Driving piles	$0.34 per lin.ft.
Cutting off piles	7.08 each
Pile cap installation	29.60 each
Laying pipe	1.76 per lin.ft.
Rock anchorages	54.04 each
Placing concrete bags	0.26 each
Anchor pin installation	6.81 each

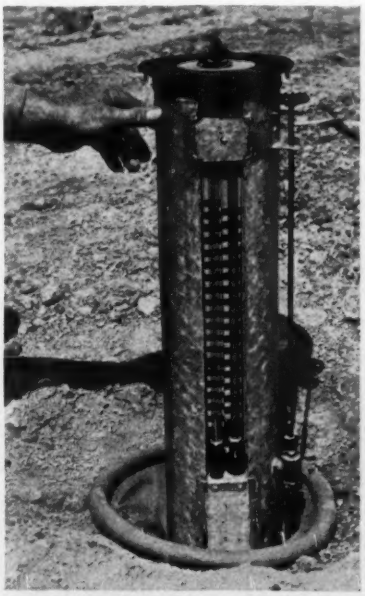
The project was carried out under the direction of Maurice A. Libby, superintendent of the Bath Water District. Fay, Spofford & Thorndike, of Boston, designed and supervised the construction of the project with the author in charge for this firm, and with W. E. Flynn as resident engineer. All construction work was done by Merritt-Chapman & Scott Corp. under the direction of Ralph E. DeSimone, New England manager, and with David B. Hill as superintendent.

Device for Measuring Volume of Soil Samples

SAMUEL R. KING
Inspector, General Construction
U. S. Bureau of Reclamation, Leavenworth, Wash.

A NEW DEVICE for measuring the volume of a soil sample taken from a pit in earth embankment in making a compaction test is shown by the accompanying illustration. It is now being used by the army engineers of the Pittsburgh district in the construction of the flood-control dams at Tionesta and Crooked Creek in Pennsylvania. It enables the volume of an irregular cavity such as a sampling pit to be readily obtained by the addition of two gage readings, one denoting the volume displaced by the apparatus and the other denoting the volume of the irregular remainder of the cavity by measuring the liquid necessary to fill it.

As indicated by the illustration, the device consists of a metal cylinder with a false bottom so that the upper section is used as a container for some liquid, usually water. A recess vertically indented in one side of the cylinder holds two glass tubes similar to those used on steam boilers. One tube is used as a channel for a float stem attached to a float which works in the lower end of the recess and denotes the level of the liquid as it rises on the outside of the cylinder. The other tube is connected directly to the tank section of the cylinder and indicates at all times the level of the fluid within the tank.



Cavolimeter for measuring volume of soil sample taken from embankment for a compaction test.

Beside the first tube is a gage calibrated in decimals of a cubic foot so as to read volume displaced by the lower end of the cylinder as the liquid rises on the outside. Beside the second tube is another gage calibrated in decimals of a cubic foot so as to read the quantity of liquid released from the tank. Both gages read in decimals of a cubic foot. To prevent absorption of the liquid by the earth, a bag is made of dental rubber sheeting and the top rolled on a ring of rubber hose. This is placed in the cavity before the apparatus is inserted.

The volume of a given cavity in cubic feet is the difference between the readings of the tank gage before and after the liquid is released plus the reading indicated by the float gage after the liquid is released.

To eliminate the necessity of leveling off the top of the test sample, a reading may be taken prior to the removal of the sample. If this is done, a mark should be placed in the wall of the cavity which will show through the rubber bag and thus can be used as the top of the liquid for both the first and second readings. After the first reading the hole is deepened and the earth carefully preserved for weighing. By deducting the volume denoted by the first reading from that of the second reading the volume of the test sample is obtained.

Numerous advantages have been noted in the early use of this apparatus. The percentage of error is materially reduced because the limits of the cavity are more definite and the liquid measuring device is surprisingly accurate. It is not even necessary to hold the cylinder absolutely plumb as the gages compensate each other.

The instrument described is the invention of the writer who reserves permission to use it. It was developed while the author was employed by the U. S. Engineering Department in the Pittsburgh District.

Wharf Gets 600 New Piles Through Old Deck

Contents in Brief—When concrete pile deterioration in a wharf at Long Beach, Calif., made extensive replacements necessary, reconstruction was greatly simplified by an ingenious scheme for drilling 18-in. holes through a reinforced concrete deck 36 in. thick. Steel H-beams were driven as replacement piles through heavy granite riprap, and their tops were encased in steel jackets filled with concrete.

SOME 600 STEEL piles of heavy H-section recently were used in renewing foundations under the reinforced concrete wharf adjoining the Ford Motor Company's assembly plant at Long Beach, Calif., where an unusual cause, found to obtain also in other waterfront structures of the vicinity, made it necessary to repair concrete below high-water level. The repair job, in the main, was done from the deck of the wharf but some ingenious planning was necessary.

A major problem that came ahead of actually replacing the old piles was the drilling of 1,200 lin. ft. of holes, 18 in. in diameter through the thick concrete deck. These holes were made by highly effective use of Ford automobile engines for driving an improvised core drill. After new piles were driven, concrete beams were cast around old and new pile tops to bind them together, and the concrete filling the 18-in. holes became dowels that firmly pinned together old and new work.

The Long Beach plant is one of three similar waterfront plants built by the Ford Motor Co. at Long Beach, Richmond, Calif., and Seattle, Wash. Pile and wharf construction of all plants was similar, the work was designed and supervised by the same architects and engineers and built by the same contractor. The Long Beach plant alone showed alarming deterioration of the concrete piles—a situation that has developed on much of the concrete work in the Los Angeles district.

This behavior, in contrast to experience in other localities, has been attributed to various causes: for example to (a) variation in portland cements, (b) chemical variation of sea water, (c) higher temperatures and lower humidities of Southern California, (d) presence of shales and other inferior material in aggregate, etc.

The belief now most generally accepted is that this concrete deterioration was caused by a fine aggregate, unsatisfactory for exposure to seawater by reason of high feldspar content. Samples of fine aggregate obtained from the same pit showed variable percentages of feldspar, ranging up to more than 40 per cent. A microscopic examination showed that much of the feldspar was partially kaolinized. Briquettes made with portland cement and some of these feldspar sands showed rapid disintegration when immersed in seawater.

The damage was limited to the zone between high water level and the mud line. Patching and jacketing the damage in this zone was unsatisfactory and it was finally decided to drive substitute steel piles for all concrete piles exposed to sea water, irrespective of condition, and to remove all the batter piles and such of the plumb piles as had been seriously damaged and which might cause future trouble by leaning into the adjoining slip. Altogether 93 reinforced concrete piles were removed.

To replace the piles taken out and to supplement the bearing value of others, additional piles driven included 600 steel H-section piles in 10-in., 57-lb., and 12-in., 74-lb. sections and also 83 piles made by driving tubular steel shells filled with concrete after driving. Shells for the tubular piles were 12¾ in. in outside diameter and had thicknesses of ⅜ in.

The wharf is 40 ft. wide, of L shape, and the two sides are 700 and 200 ft. long, respectively. For the most part the new piles were spaced midway between the old piles, which put them on 6½-ft. centers in the line of the cap, with bents spaced 10 ft. apart. The location of each new pile was marked on top of the wharf deck as a preliminary to drilling holes in the concrete.

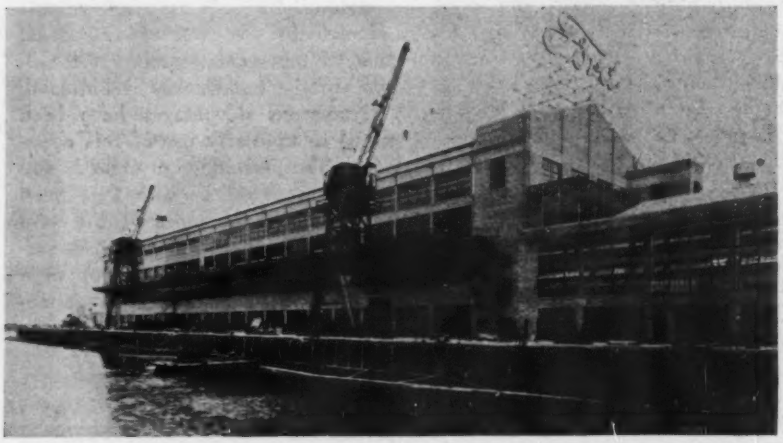


Fig. 1. Wharf which was repaired extends for 700 ft. in front of a large warehouse and also runs for 200 ft. across the far end.

Drilling through concrete

Diameter of the cored holes was fixed by the diagonal of the 12-in. steel beams, which was 18 in. The bit found most suited to drilling through the reinforced concrete deck was a short section of standard 18-in. pipe in whose periphery two diametrically

opposed notches were cut. Hardened steel "shot" in these notches made the bit function as a shot drill.

Power for rotating the drill was most conveniently supplied by the standard model A Ford automobile motor, which was used with chassis complete except that the differential was rotated through 90 deg. so that instead of having a horizontal rear axle the driving power was delivered through a vertical shaft. By making this shaft a 2x2-in. square bar, power could be transmitted continuously as the shaft moved downward freely and steadily under the weight of the bit advancing in the drilled hole. To facilitate this advance the square shaft was made long enough to project, at the start, some 4 ft. above the differential housing.

This improvised shot drill made such excellent progress that only three duplicate rigs were required to complete the 1,200 lin.ft. of drilling in less than three months. Rates of progress varied with the amount of reinforcing and other materials encountered in the concrete, but frequently averaged 1 in. each 18 min. for long periods. The shot drill cut through steel reinforcing very satisfactorily but was slowed up considerably when wood ties were encountered. As portions of the core broke off they were lifted out; if they did not break off it was not unusual to continue through the hole and allow the core to drop out at the bottom.

These drill rigs made notably clean holes with no spalling at the bottom. A particularly good feature was that they did not disturb the bond with the steel as would have been the case if the holes had been punched through with compressed air drills in the manner ordinarily used in breaking up concrete.

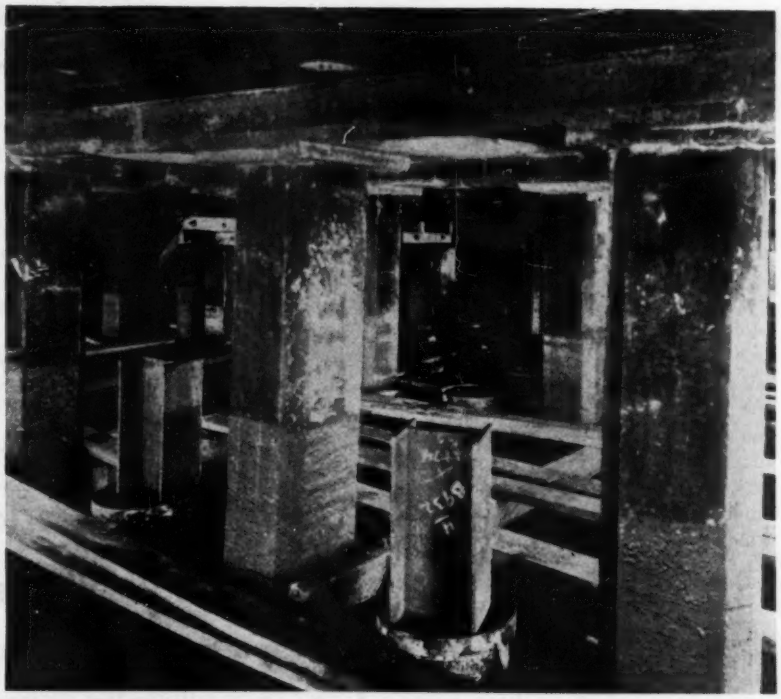


Fig. 3. Under side of wharf showing new H-piles which were driven through holes in deck. Note steel jacket hung on temporary support. This jacket extends down to mudline and on extension on top will extend to a new transverse cap beam tying new and old piles together.

To keep the diameter of the cored holes to a minimum the steel jackets for the upper end of the piles were not put down through the holes but were brought into place beneath the deck and were suspended from its under side. Thus the steel piles were driven through the jackets. Jackets of varying length were used, in each case the length was enough to extend from the under side of the deck to low water level. After the steel piles were driven a wood gasket was bolted into place to close up spaces around the pile at the bottom of the jacket. Then, after a reinforcing cage had been put inside, concrete was poured to fill the jacket completely. In this way there was afforded considerable leeway in estimating the required length of the steel piles. The driving could be stopped anywhere between the level fixed by the top of the jacket and a line some 3½ ft. above low water mark, (fixed as the level at which proper bearing would be secured). This was a great convenience because of the expense that would have been involved if the steel H-sections had required to be cut off to grade.

Steel piles were brought to the job in lengths not exceeding 40 ft., which was the maximum that could be

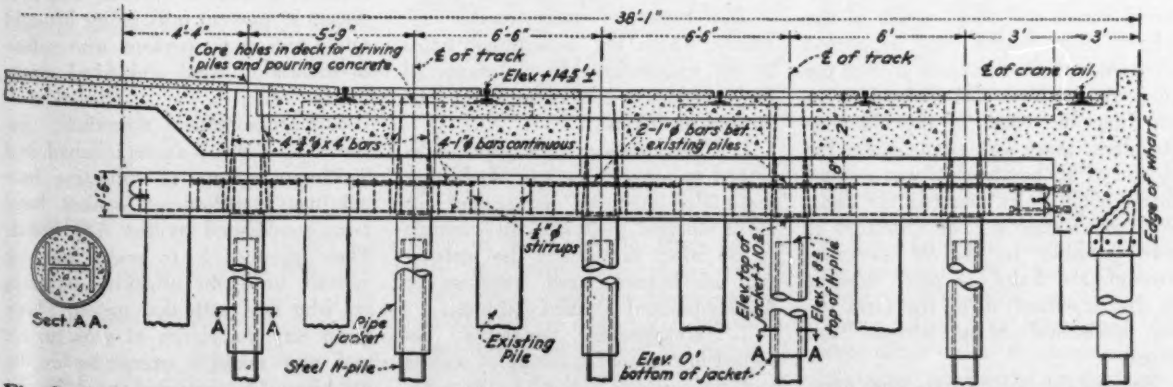


Fig. 2. Cross-section through wharf deck indicating relative location of old and new piles and the new tie-beam that bonded them together. Section A-A is a cross-section of the new piles, showing how steel is encased in concrete.

shipped by rail without increase in standard freight rates. As most of the pile lengths were between 60 and 75 ft. this meant splicing all piles. Splicing consisted of welded butt joints in the steel H-beams, the welding having been done in a conveniently located welding yard. At first the joints were welded on one side only of flanges and web. This was unsatisfactory in some cases, as the beams drifted as they were driven, and tore the welds. This trouble was entirely stopped when welding was done around the entire periphery of the butt joints. One such weld was required in all piles and for those driven under a projection overhanging from the adjoining warehouse, where headroom was limited, two welds (three sections) were required.

Driving through heavy riprap

Around the piles which were driven in the original wharf construction, granite riprap had been placed in quantities sufficient to form layers 16 to 18 ft. thick. This riprap was of heavy stone whose linear dimensions were frequently 3 to 4 ft. At first there was some question as to whether it would be possible to drive piles through this fill. However, other than the twisting and need for double welding already mentioned, no difficulties were encountered and all piles were put down at the locations fixed by the holes drilled in the deck for them.

After the jackets had been filled with concrete, steel reinforcing for a new floorbeam, below the old cap, was fastened in place and a wood form was built around the top of the piles, both new and old, in each bent. The form was made to provide for a beam 3 ft. wide and 18 in. deep, this beam, like the smaller one in the original construction, extending entirely across the 40-ft. width of the wharf. Beam forms were supported by framing bolted in place around the piles. As the form was 6 in. wider on top than the beam of the old construction, there was ample space for escape of air as concrete was poured through the holes piercing the deck. With consistent use of vibrators it was possible to deliver concrete through the holes on 6½-ft. centers so that it entirely filled the form for the horizontal beam between the holes.

Because the beam forms were open along the upper edges, concrete put down through the holes in the deck might have spilled over these open tops immediately adjacent to the holes had there been no restraint. Spilling was prevented by nailing covers on the forms close to the holes, thus making the vibration effective in working concrete out into the beam. When the beam forms were stripped a remarkably dense concrete surface was exposed indicating effective bonding of old and new work to the wharf deck.

This replacement of all necessary piles, plus some grouting done beneath the bearing wall at the inner edge of the wharf is believed to have completely restored the bearing quality of the structure so that it can continue to fulfill the function which was intended when it was originally built.

The work was done by the Tavares Construction Co., Ltd., Los Angeles, for the Ford Motor Co., according to designs prepared by Frank G. White and H. E. Squire of San Francisco, working in collaboration with the power and construction department of the Ford Motor Co.

Labor Union Activities To Be Investigated

LABOR UNION activities that increase the cost of construction are to be included in the present investigation of the construction industry, according to Thurman Arnold, Assistant Attorney General. Mr. Arnold made this statement in a letter to William Hutcheson, head of the carpenters' union of the American Federation of Labor. In his letter he stated that it was not the purpose of the Justice Department to use the anti-trust laws to police strikes or interfere with collective bargaining. What would be subject to action are the efforts of unions to perpetuate unnecessarily costly and uneconomic practices. Immediately following the publication of Mr. Arnold's letter, William Green, president of the AFL, challenged the power of the Department of Justice to bring any action against labor unions under the anti-trust laws.

The types of unreasonable restraint which the department holds to be unquestionable violations of the anti-trust act were listed by Mr. Arnold as follows:

1. Unreasonable restraints designed to prevent the use of cheaper material, improved equipment or more efficient methods. An example is the effort to prevent the installation of factory-glazed windows or factory-painted kitchen cabinets.

2. Unreasonable restraints designed to compel the hiring of useless and unnecessary labor. An example is the requirement that on each truck entering a city there be a member of the local teamsters' union in addition to the driver who is already on the truck. Such unreasonable restraints must be distinguished from reasonable requirements that a minimum amount of labor be hired in the interests of safety and health or of avoidance of undue speeding of the work.

3. Unreasonable restraints designed to enforce systems of graft and extortion. When a racketeer, masquerading as a labor leader, interferes with the commerce of those who will not pay to leave them alone, the practice is obviously unlawful.

4. Unreasonable restraints designed to enforce illegally fixed prices. An example of this activity is found in the Chicago milk case, where a labor union is charged with combining with distributors and producers to prevent milk being brought into Chicago by persons who refuse to maintain illegal and fixed prices for the milk.

5. Unreasonable restraints designed to destroy an established and legitimate system of collective bargaining. Jurisdictional strikes have been condemned by the AFL itself. Their purpose is to make war on another union by attacking employers who deal with that union. There is no way the victim of such an attack may avoid it except by exposing himself to the same attack by the other union.

Storm Causes Floods Below Boulder Dam

L. J. FOSTER

Construction Engineer, All-American Canal, Yuma, Ariz.

DESTRUCTIVE FLOODS resulting from abnormal rainfall swept the lower Colorado River valley in California and Arizona in the early days of September. Extensive damage was done to shore lands, the main canal of the Yuma irrigation project, and the canals and lands of the Imperial Irrigation District. The occurrence is the most severe of the kind since floods originating in the mountains and canyon section of the Colorado River were controlled by the completion of Boulder Dam, and is the more remarkable because the Gila River, which was believed to be the principal remaining source of lower river floods, contributed little or no water on this occasion.

A tropical hurricane sweeping northeasterly across the region of southern California and western Arizona from an origin in the Pacific Ocean off Lower California resulted in one of the heaviest rainfalls of record over the lower Colorado River area, including Bill Williams River, Parker Dam, Yuma, Imperial and Coachella valleys. The storm lasted ten days; the maximum rainfall, which occurred during Sept. 4–6 inclusive, caused the most severe floods since completion of Boulder Dam controlled up-river floods.

Records of the rainfall at different locations are as follows:

Yuma, Ariz.—Weather Bureau observations:

Sept.		Inches	Inches
4	In a.m.		Trace
	During 1½ hr., p.m.		2.17
5	12 midn't to 5:30 a.m.	0.57	
	5:30 a.m. to 11:30 a.m.	0.88	
	11:30 a.m. to 5:30 p.m.	0.46	
	5:30 p.m. to 11:30 p.m.	0.11	2.02
6	11:30 p.m. (5th) to 5:30 a.m.	0.10	
	5:30 a.m. to 11:30 a.m.	0.16	0.26
	Total rainfall Sept. 4 to Sept. 6		4.45
11	5:12 a.m. to 8:30 a.m.	0.51	
12	10 p.m. to 6 a.m., aprx.	0.10	0.61
	Total rainfall Sept. 4–12		5.06

Imperial, Calif.—Records of Imperial Irrigation District (6 a.m. of previous day to 6 a.m. of date).

Sept. 5	0.39 in.
Sept. 6	4.08 in.
Sept. 7	0.55 in.
Sept. 9	0.01 in.
Sept. 13	1.84 in.
Total rainfall Sept. 4–13	6.87 in.

Other Points—Department of Agriculture, Division of Irrigation; Sept. 4 to 6 inclusive.

Needles	5.70 in.
Parker	5.45 in.
Blythe	4.62 in.
El Centro	4.31 in.
Indio	2.03 in.

As a result of the rains, the reservoir behind Parker Dam started rising at 2 a.m., Sept. 5, and reached a maximum elevation at 11 a.m. on the 7th, when approximately 660,000 acre-ft. were impounded. The greatest inflow into the lake occurred about 1:30 a.m., Sept. 7, when the total reached 146,000 cfs. With 9,160 cfs. released at Boulder Dam for power requirements only, the runoff from the storm entering the lake was 136,840 cfs.

By utilizing the storage capacity of the reservoir to absorb this tremendous peak, it was possible to limit the discharge past Parker Dam to a maximum of 48,777 cfs., thus preventing flooding of any save the marginal lands along the lower reaches of the river. At Yuma the flow had been so reduced by channel storage and operation of the Imperial diversion dam that the maximum discharge had been reduced to 34,400 cfs.

The value of these recent structures in flood control is fully appreciated when it is realized that the maximum flow of the Colorado River at the site of Parker Dam since records were established was approximately 185,000 cfs. in June, 1921, when the river nearly overtopped the levees of the Imperial Irrigation District in Mexico and seriously endangered the valley.

The All-American Canal weathered the storm admirably. Other than minor instances of erosion to the banks, as yet unset after excavation, no damage was sustained. There are ten major structures carrying wash courses over the canal and thirteen minor inlets draining into it, in the first 21 miles through the region adjacent to the Colorado River between Imperial Dam and Pilot Knob, draining approximately 97,850 acres or 153 sq.mi. All but five of these structures functioned in discharging 25,000 acre-ft. of stormwater from the terrain above the canal. Unnamed and Picacho washes are the largest, Unnamed draining an area of 22,592 acres, and Picacho an area of 26,560 sq. acres. It has been estimated, from high water marks on the structures and in well defined sections of the channels above the canal, that Unnamed Wash discharged a flash flood of 5,000 cfs and that Picacho reached the unprecedented peak of 37,000 cfs.

Although safely carried across the All-American Canal, the volume of water was too great for the protection works of the Yuma project main canal; several bad breaks occurred and considerable embankment was destroyed. At Bee Wash, about halfway between Picacho Wash and the Siphon Drop power plant, the flow carried considerable debris, consisting mainly of sand and gravel, into the Yuma Main canal, damming it completely.

This condition threatened the Valley Division of the Yuma Project with a serious water shortage as planting of lettuce was in progress and large herds of stock were dependent on this source for their drinking water. Therefore, upon request of the officials of the Yuma County Water Users' Association, the commissioner's office granted permission to furnish 500 cfs of water to the Yuma main canal at Siphon Drop through the All-American Canal and the turnout provided for ultimate service at that point. Accordingly, on Sept. 11, water was turned into the All-American Canal through the bypass channels of the desilting works at Imperial Dam; and, by checking the canal at the Pilot Knob check and wasteway structure, service to the Yuma Canal was established. The impending water shortage was thus alleviated for nearly a month while repairs were being made to the latter canal.

Beyond Pilot Knob the All-American Canal was practically unharmed.

Imperial and Coachella valleys suffered the greatest damage. Nearly every wash and water course ran full and many (with the exception of Alamo and New rivers) exceeded their previous maximum records. In a number of instances the channels were insufficient to carry all the water, and the runoff flowed as a sheet over the adjoining land cutting numerous gulleys varying in depth from inches to several feet. The accumulation of this drainage in the Salton Sea amounted to approximately 230,890 acre-ft., raised the surface of the sea 1.2 ft., and flooded 4,251 acres.

So much water collected in the towns of Brawley and El Centro that it filled the streets and stood in many of the business houses and residences. In some parts of Calipatria water stood 3 ft. deep. Truck gardens in many places were covered with several inches of sand and silt, leaving the fields perfectly flat, but eroded by large gulleys.

Imperial district damage

The Imperial district's canal system suffered probably the worst damage since the disastrous floods of 1905-06-07. Many of the canals were obliterated, others became uncontrolled flood channels, and miles of laterals were so devastated that it will be necessary to reconstruct them. It has been estimated that the cost of reconstruction will exceed $350,000, and that even temporary repairs will not permit delivery on part of the system for six months, and that it will be a full year before order is attained. In many instances it will be impracticable ever to restore the former conditions.

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Good Safety Record On Golden Gate Bridge

Only 14 traffic accidents, all minor, occurred in the first 25 months' operation of the Golden Gate Bridge, according to the report of the Golden Gate Bridge and Highway District just issued. No fatalities and no hospital cases resulted, and all vehicles were removed under their own power. The record covers 4½ miles of bridge and approach roadway, and represents 35,000,000 vehicle miles of traffic. A special detail of the California Highway Patrol serves the bridge.

Moving Earth at 2½c. per Yard By Hydraulic Sluicing

A FIVE-YEAR hydraulic sluicing program was recently completed in Trinity County, Calif., where 10,748,000 cu.yd. of material was moved at a cost of less than 2½c. per cu.yd. In planning the new highway between Weaverville and Junction City, unusual conditions affected the final program. The first was that construction men of the region had had experience with hydraulic sluicing as the result of mining operations, and the second was a decision to use convict labor on other parts of the new route. Use of such labor fitted in well with a hydraulic sluicing program that would require several years.

Detailed figures on the monthly quantities and operating cost of the hydraulic sluicing operation are given in a recent issue of "California Highways and Public Works".

200-ft. cut

Final decision on the route was influenced by the fact that it was found feasible to decrease the summit elevation by making a cut 200 ft. deep through the summit ridge on mining properties of the La Grange Mine, where hydraulic sluicing operations were carried on from 1862 to 1918. From this mine was leased sluicing equipment and water rights; even some of the men who had worked on the mine were employed to operate the sluicing nozzles.

Hydraulic sluicing on the highway cut began in February, 1934, and was completed June 30, 1939. In the early part of this period sluicing was carried on from October to July. To prevent pollution of the Trinity River during the summer season, operations during the last two winters have been limited to a December-to-June period.

Equipment from the mining company included five hydraulic giants with 7 to 9-in. nozzles served by pipes 15 to 26 in. in diameter permitting operating heads of 100 to 204 lb. per sq.in. With the 9-in. nozzle the velocity was stated to be 126 ft. per sec. and for the 7 and 8-in. nozzles, as much as 170 ft. per sec.; quantities of flow of the sluicing water ranged up to 55 cfs.

With jets of this sort, even large boulders could be moved in loose material. Where a harder formation was encountered a tunnel some 600 ft. long was dug along the center line at grade. Pockets along this tunnel loaded with a 40-ton powder charge so loosened the formation that it also could be hydraulicked. Generally speaking the tailings were not used in fill.

The hydraulic cut is 2,500 ft. long, 2,000 ft. wide at the top and 210 ft. deep. Its bottom ranges from 50 to 250 ft. wide; the greater width allowing for sloughing the weathered material in the deep cut. Grading to follow the hydraulicking in the deeper part of the cut will go down an additional 60 ft. Some of the remaining material could have been removed hydraulically, with the aid of powder, but as the material is needed for fills at either end of the cut there would be no advantage in sluicing it out. This additional excavation is now being made with convict labor.

Compiling data

In compiling data on the hydraulicking operation, the duty of water was rated in cubic yards of material moved per miner's inch per 24 hr. The per cent of carry was recorded as the ratio of solids moved to quantity of water used, both values being in terms of cubic yards. A total of 55,524,400 cu.yd. of water passed through the giant in moving 10,748,000 cu.yd. of material. The average excavation rate was 8,060 cu.yd. per day or 1,310 cu.yd. per operating hour. The average carry was 19.3 per cent solids and the unit cost of excavation, with all factors considered, was 2.47c. per cu.yd.

The work was done under the general direction of C. H. Purcell, state highway engineer of California.

Trusses Put Under Heavy Dome To Permit Removal of Walls

FRANCIS J. NIVEN
Consulting Engineer, Houston, Texas

IN ORDER TO INCREASE the seating capacity of the auditorium of the Second Baptist Church in Houston, Tex., the east and west walls, which supported a 500-ton dome, were required to be moved out 26 ft., making the room 52 ft. wider. The engineering problem involved was to transfer the dome load from the wall buttresses to new trusses without cracking the expensive molded plaster ceiling and art glass in the dome.

The first step was to erect the new trusses above the ceiling and directly over the load-bearing buttresses. These trusses were supported on new columns. Next, the end-connections of the old roof trusses through which the dome weight was carried to the wall buttresses were welded in order to relieve the stress in the old rivets and permit cutting a 3-in. diameter hole through the bottom chord about 3 in. from the end. These holes in the old trusses matched similar holes in hangers attached to the new truss above so that a 3-in. pin could be driven to effect the connection.

After the pin-connection was completed, wedges were driven under the columns supporting the new trusses, which thus were raised sufficiently to pick up the dome load. A 1½-in. camber allowed at the center of the new trusses leveled out as the old trusses were raised off their bearing plates.

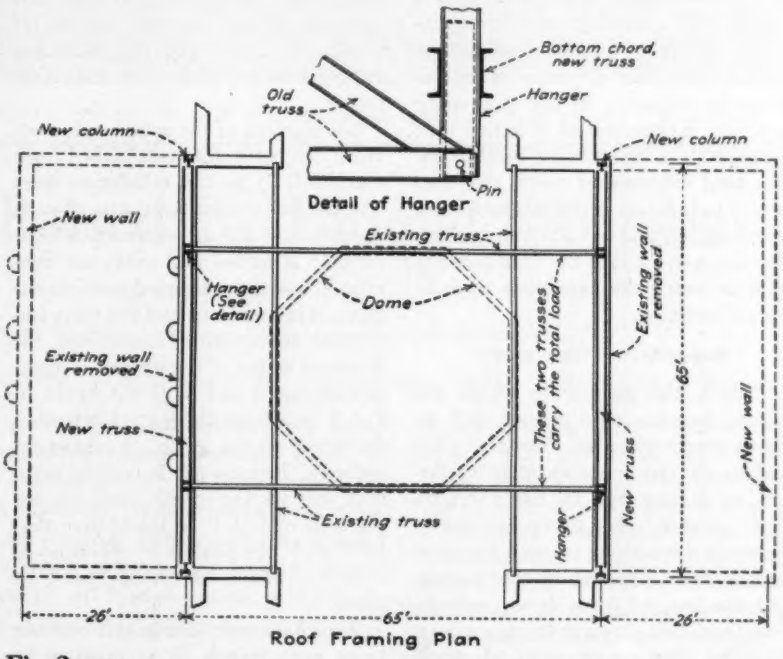

Fig. 2. New trusses picked up dome through hanger connections to old wall-bearing trusses.

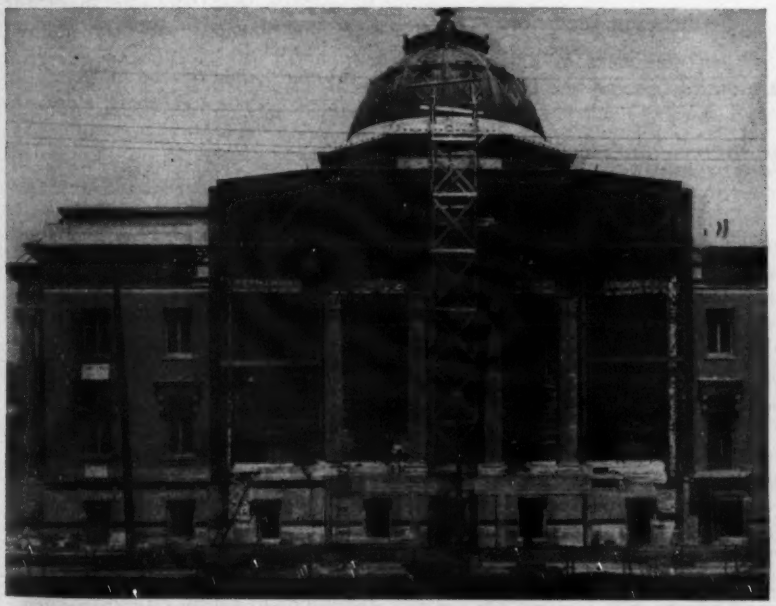

Fig. 1. With new trusses in place and supporting the dome, the existing wall is being taken down to be built 26 ft. farther out.

The writer was the structural engineer, T. D. Howe the general contractor, and Wirtz and Calhoun, the architects, all of Houston.

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Pavement Costs Reduced With Asphalt Plant

An asphalt processing plant that cost San Angelo, Tex., $1,525 has saved more than four times that amount in the cost of pavement material during the past five years, according to the International City Managers' Association. The city previously paid two cents a gallon for asphalt street covering purchased from commercial concerns. The new plant heats, distributes and applies the asphalt for a total cost of about ¾c. per gal.

The city has processed about 500,000 gal. of the street coating since its installation.

Getting Efficiency from WPA Labor

LABOR OPERATIONS on WPA construction projects in Rhode Island are "measured" twice a month by administration headquarters as a means of expediting work and providing a check on the efficiency of production. The report system devised by engineers in the state office provides a comparison of actual unit costs with a previously established standard schedule of costs, and also serves to indicate whether a project is keeping within its allotted budget. Furthermore, it aids the headquarters staff in rating the capability of individual foremen.

Records tell the story

This is the manner in which the system operates on a project such as sewer construction or water main installation: The superintendent of the project is required to file a report with the state office every two weeks covering the activity of each foreman and his crew. This report summarizes (1) the type of work done (excavation, backfilling, pipe laying, etc.); (2) the number of units of work accomplished for each item such as cubic yards of excavation or board feet of sheeting; (3) the total labor cost on each item; and (4) the unit cost for each item.

At the state office this information is translated to a master sheet for the project on which is also compiled additional data showing, among other things (1) the established unit cost for each item; (2) the amount of work to be done; and (3) the funds required to complete each item (see table).

Comparison of the actual unit costs (Col. 5) with the established unit cost (Col. 7) on this tabulation sheet quickly determines the status of each operation so far as efficiency is concerned; if actual unit costs are running above the estimated cost, an inquiry is launched to find out why. Important information concerning the financial status of the project is given in columns 8 and 9. If the figure in Col. 8 (funds available) is lower than the figure shown in Col. 9 (funds required), then the job is costing more than was originally estimated. Should the total of Col. 8 be lower than that for Col. 9, the project is operating at a deficit, and some change must be made.

With data compiled in this manner twice each month, it is possible to maintain close scrutiny on the progress of the job.

Checking inefficiency

When unit costs of a labor crew are out of line, say the Rhode Island WPA officials, an investigation is made of the capability of the foreman in charge. He is shifted to another crew and given a trial on a different section of the project. If he again fails to produce work close to the established rating, he is then demoted and put in the gang with a shovel. Experience has proven, it is said, that this is an effective way of maintaining efficiency and labor morale.

In cases where work is delayed because the municipality sponsoring the project is wilfully delinquent in supplying tools or materials, instructions are issued to lay off the labor crew until such time as the needed equipment is at hand. This has been found to be an effective procedure.

The report and tabulation system used by the Rhode Island Work Projects Administration were developed by William Steimer and Arthur A. Sullivan, director and assistant director of operations, respectively, under the direction of Farrell D. Coyle, state administrator.

SEMI-MONTHLY JOB REPORT GIVING UNIT COST AND OTHER DATA FOR WPA PROJECTS

Operations	1 Est. Quant.	2 Est. Cost	3 Quan. done	4 Cost	5 Unit Cost	6 Quan. to do	7 Est. Unit	8 Balance Alloted	9 Funds Required
Surface off	3,400 sq. yd.	$1,020	96	$15	$0.16	3,304	$0.30	$1,005	$991
Earth excavation	11,000 cu. yd.	16,500	629	947	1.50	10,371	1.50	15,553	15,557
Rock excavation	2,000 cu. yd.	11,000	84	453	5.39	1,916	5.50	10,547	10,538
Backfill and disposal	13,000 cu. yd.	7,800	671	327	0.49	12,329	0.60	7,473	7,397
Sheathing out	10,326 lin. ft.	3,614	176	56	0.32	10,150	0.35	3,558	3,553
Sheathing in	10,326 lin. ft.	5,163	456	158	0.35	9,870	0.50	5,005	4,935
Pipe	5,163 lin. ft.	3,097	232	97	0.42	4,931	0.60	3,000	2,959
Manholes (3-way)	32 ea.	1,280	1	76	76.00	31	40.00	1,204	1,240
Catchbasins	2 ea.	70	.....	.....	.....	2	35.00	70	70
Inlets	.....	.....	.....	.....	.....	.....	.....	.....	.....
Traps	18 ea.	90	.....	.....	.....	18	5.00	90	90
R. C. B.	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rep. (mac.)	800 sq. yd.	1,600	.....	.....	.....	800	2.00	1,600	1,600
Watchmen	.....	2,000	.....	229	.....	.....	.....	1,771	1,771
Contingency fund	.....	200	.....	67	.....	.....	.....	133	133
Overhead	.....	3,981	.....	707	.....	.....	.....	3,274	3,274
Tool, light and flagmen	.....	2,000	.....	198	.....	.....	.....	1,802	1,802
Totals	.....	59,415	.....	3,330	.....	.....	.....	$56,085 −55,910	$55,910

Estimated unit costs are established by the state office based on experience with previous jobs.

$175 Amt. by which project is under original allotment.

Col. 5 = Col. 4 ÷ Col. 3; Col. 6 = Col. 1 − Col. 3; Col. 8 = Col. 2 − Col. 4; and Col. 9 = Col. 6 × Col. 7.

School Students Desirable Waterworks Visitors

Worthwhile benefits are to be had from visits by groups of high school students to pumping or treatment plants of the water department in their home town, according to comment at a roundtable discussion of the recent American Water Works Association section meeting held at San Francisco.

Young people can be more readily interested than can their elders in the water department operation; information gained at an impressionable age will be long remembered and discussion of such visits takes knowledge of the plant into the homes of a community. Arrangements could be made, it was suggested, for each successive freshman class of a high school to make one such visit to the plant.

Interest can be increased by offering a prize for the best essay on the plant, or by cooperating with the instructor in getting out a set of questions and having the papers graded. Periodic visits of this sort develop the pride of the department employees in plant appearance, and build up in the minds of future citizens a knowledge of local conditions and problems.

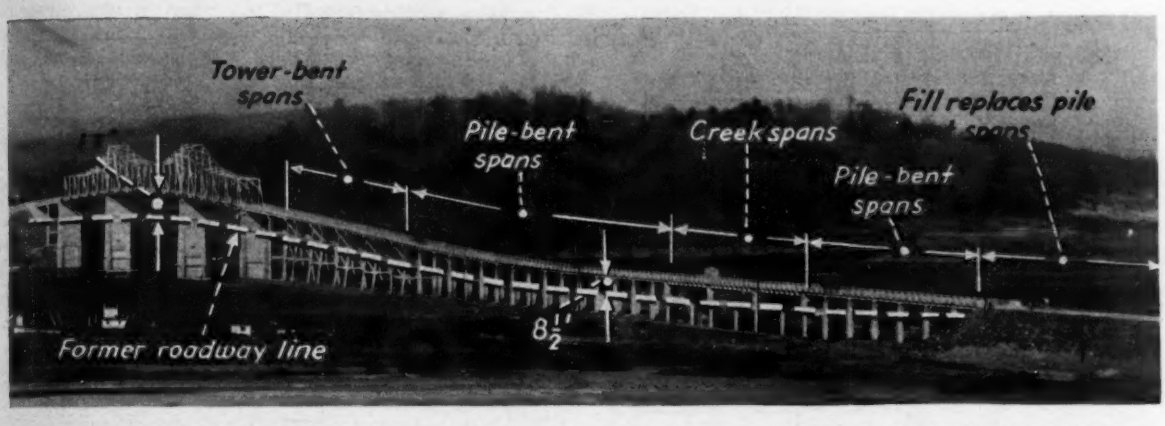


FIG. I. CONTINUOUS TRUSS BRIDGE AND APPROACHES WHICH TVA RAISED TO CLEAR ITS GUNTERSVILLE RESERVOIR.

Long Bridge Raised By Unique Procedure

ERWIN HARSCH

Senior Highway Bridge Engineer, Tennessee Valley Authority, Chattanooga, Tenn.

Contents in Brief—Reservoir created by TVA Guntersville Dam floods concrete viaduct approaches and reduces shipping clearance of 767-ft. 3-span continuous steel truss over Tennessee River at Guntersville, Ala. Steel bridge raised 17 ft. by jacking. Concrete viaduct raised by a novel reconstruction scheme involving a gantry that lifted spans to ground, or held them suspended, while old bents were raised or new higher bents built on new piles. Total length of bridge raised is 2,505 ft., and 766 ft. of approach viaduct was demolished and replaced by a fill.

AS A RESULT of the reservoir created by Guntersville Dam of the TVA, an unusual bridge-raising operation was required on the state highway crossing of the Tennessee River on U. S. 241 just north of the town of Guntersville, Ala. Involved was a three-span 767-ft. continuous steel truss, which was lifted 17 ft. as a unit, and nearly 1,600 ft. of approach structure (both concrete T-beam and steel girder construction), the spans of which were raised distances varying from 8½ to 17 ft. with the aid of a novel gantry crane. A total of 766 ft. of the concrete approach was abandoned in favor of an embankment built up above pool level. The design was prepared by the engineering forces of the Tennessee Valley Authority who also worked out the construction procedure that was followed except for the idea of using the gantry crane, which was originated by the contractor, Rust Engineering Co., Pittsburgh. During the period when the bridge was out of service ferries were hired by the TVA to transport the highway traffic across the river.

General plan

The bridge crosses not only the main channel of the Tennessee River but also an island and a back channel or creek adjacent to the south bank. Starting at the south or Guntersville end, the roadway rose on a 0.2 per cent grade for 1,640 ft. where it joined a 200-ft. vertical curve connecting with a 5 per cent grade leading to the channel span. A vertical curve in this span connected with a 5 per cent grade that continued to the north abutment, located on a rock bluff.

Starting at the south end, the first 21 spans of the concrete T-beam approach, extending nearly to the bank of the creek, were supported on bents of four 14-in.-square concrete piles extending about 20 ft. above the ground. These pile bents were not capable of being extended to support the superstructure after it had been raised the required 8½ ft. so they were removed and replaced with an earth embankment at a saving of some $25,000 over any reconstruction scheme. The resulting reduction in waterway was more than made up by the increased depth under the remainder of the bridge.

For the remainder of the pile bent spans, 7 south of the creek and 16 north of it, it was found most economical to build new reinforced concrete column bents to support the existing superstructure. These bents, of conventional two-column type, ranging in height from 26 to 44 ft. overall, were supported on new concrete piles, since there was much uncertainty as to the bearing power of the existing piles. Inasmuch as there was insufficient headroom for the pile driver under the superstructure the new piles had to be placed outside the present bridge and therefore eccentric with the columns that they supported. This eccentricity was taken care of by a heavy beam connecting the footings at opposite ends of each bent. Since this beam passed directly over the location of the existing piles it was decided to cut off these piles and incorporate them in the footings for whatever they might be worth.

Bents over 32 ft. high were designed with an intermediate horizon-

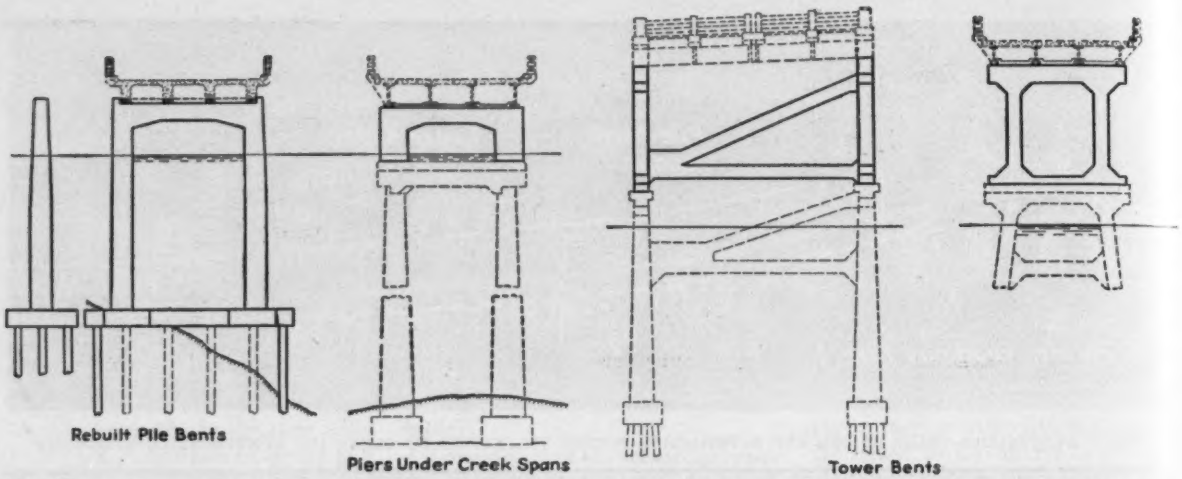


Fig. 2. Three types of foundations in Guntersville Bridge approach which were raised or rebuilt to a height of 8½ to 17 ft. above their previous top elevation. Solid lines indicate new construction, dotted lines the existing structure.

tal strut at about mid-height, and to obtain as much duplication as possible the uppermost 17 ft. was made identical for all bents and the lower sections of the columns were made of the same uniform rectangular section, differing only in height. In the new design the viaduct was divided into groups of three or four spans, and 4-in. steel rollers were placed under the end bearings of each group, the intermediate bearings being grouted solidly on the bents.

The three steel-beam spans over the creek were carried on two-column reinforced concrete bents which were sufficiently stable to permit extension, and a design was adopted consisting of simple portal frames of structural steel which could be set on the existing bents and incased in concrete to conform to the appearance of the remainder of the bridge.

Between the T-beam viaduct and the south end of the continuous truss, the approach consisted of seven steel beam spans supported on five reinforced concrete towers and a two-column reinforced concrete bent. The beams were 80 ft. long consisting of a 50-ft. span between towers and 15-ft. cantilever projections to the center of the towers. In the new design these beams were raised 17 ft. and supported on structural steel frames set on the tops of the towers and subsequently incased in concrete to conform to the general appearance of the tower below. The same general scheme was used for the extension of the two-column bent adjacent to the south end of the river bridge.

As to the river bridge, investigation of the existing piers, consisting of two relatively slender reinforced concrete columns connected below the high water line by an 18-in. concrete web wall, indicated they could support the superstructure in its raised position without any changes in the foundations or lower part of the shaft. Research in technical publications, however, disclosed no precedent for raising a continuous truss of this type. Analysis showed that it was not feasible to cut it apart and raise the several spans separately, or at varying rates, because of the danger of overstressing some of the members. To reduce the weight by removing the concrete roadway would have been too expensive. Accordingly, it was decided to lift the span as a unit. This required that all eight points of support be raised at

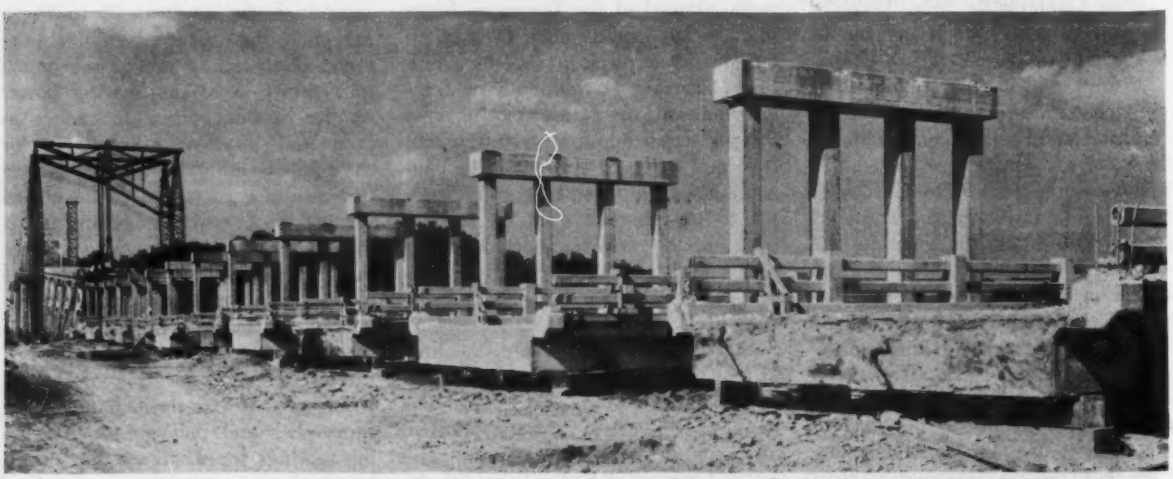


Fig. 3. T-beam approach spans weighing 80 tons each were removed and laid on the ground by a gantry crane, so that new higher two-column bents could be built. After the caps were removed from the old four pile bents shown, the piles were driven to 40-ton refusal, cut off and incorporated in the new footing.

the same rate in order not to overstress the truss members, although, after making a suitable allowance for temporary increase of working stresses, it was found that either end reaction could be varied as much as 7 in. either up or down from its normal position with relation to the intermediate reactions without any overstressing. The specifications, however, set the limit of such variations at 3 in.

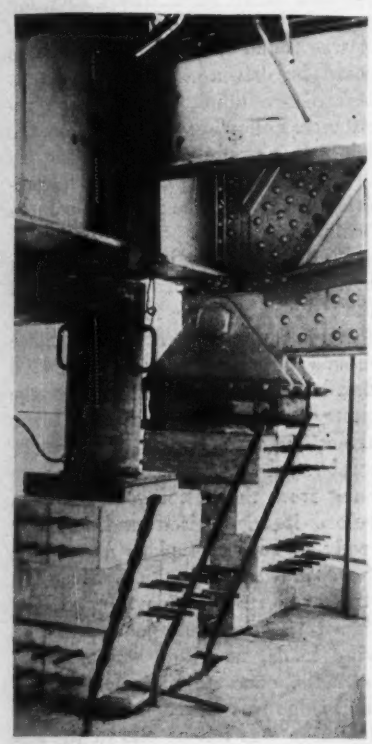


Fig. 4. Typical jacking arrangement for lifting the three-span continuous truss. The concrete shoring blocks were incased in pier concrete.

The scheme finally adopted consisted of raising the truss in short lifts by means of eight jacks, two at each pier, placed under the floorbeams a sufficient distance inside the truss bearings to provide the necessary working clearances. Since the existing pier caps were inadequate to support the jacks, it was necessary to strengthen the piers by pouring a solid concrete web entirely filling the opening between the columns. Also the existing floorbeams over the piers had to be reinforced, while at each intermediate pier it was necessary to install a temporary 48-in. jacking girder, located above the roadway slab and directly over the floorbeams through which the load was transmitted to the jacks.

The convenience and practical necessity of simultaneously raising the river bridge and the viaduct spans adjoining its north and south ends resulted in the provision of a system of temporary beams and hangers to transfer the reaction of the viaduct spans to the jacks under the ends of the trusses, as shown in Fig. 5.

Raising the continuous truss

The jacking program for the 767-ft. continuous truss called for lifts of 8 in. After each lift, a layer of precast concrete blocks exactly 8 in. thick was placed under each truss shoe, and the shoe allowed to bear thereon. The jacks were then released and a similar layer of concrete blocks was placed under them. This procedure was then repeated, the blocks in each layer being placed at right angles to those in the layer below to form a solid cribwork. After each four or five lifts, jacking operations were suspended and the concrete pier extension poured, entirely inclosing the cribbing. The construction joints were spaced evenly and finished with grooves to give a pleasing appearance.

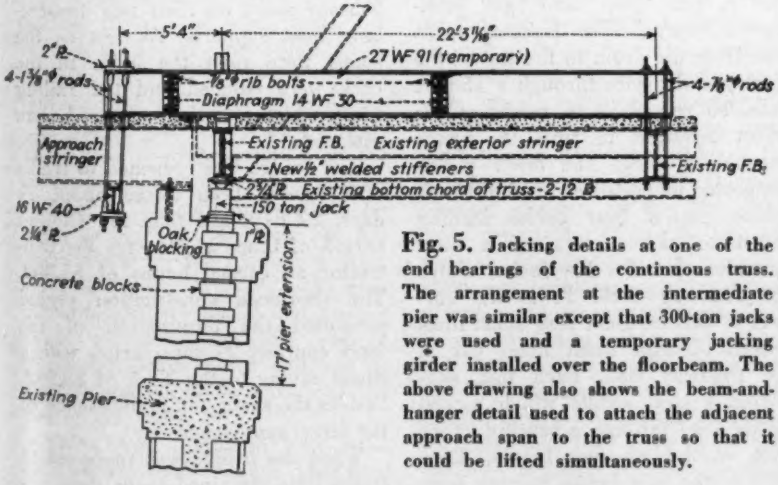


Fig. 5. Jacking details at one of the end bearings of the continuous truss. The arrangement at the intermediate pier was similar except that 300-ton jacks were used and a temporary jacking girder installed over the floorbeam. The above drawing also shows the beam-and-hanger detail used to attach the adjacent approach span to the truss so that it could be lifted simultaneously.

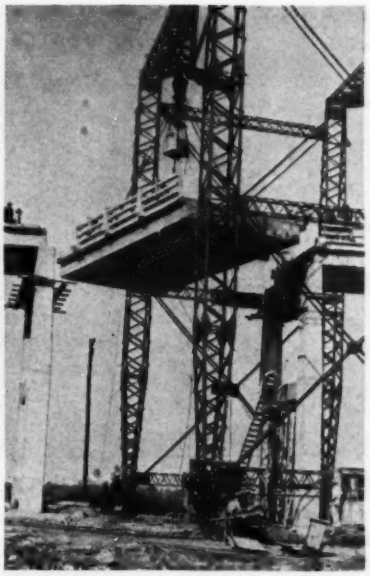


Fig. 6. Gentry crane replacing one of the T-beam approach spans on its new supports.

The concrete blocks were cast on the job and, in order to insure accuracy, cast iron sideforms having machined faces were used. Some 1,400 blocks were made in a period of two months, and showed an average strength of 5,000 lb. per sq.in. at 28 days.

Eight hydraulic jacks were used, four of 300 tons capacity at the intermediate bearings and four of 150 tons capacity at the end bearings. One man operated the pump for each of the smaller jacks, and two men were placed on each of the larger jacks. Trusses were raised about 1 in. per 80 strokes so that it did not take long to complete an 8-in. lift. A steel pipe accurately marked off in feet and inches was grouted vertically in the pier concrete at each bearing, enabling the elevation to be read to $\frac{1}{16}$ in. at any time by the use of an ordinary rule. Actually the raising proceeded by 1 in. increments, all bearings being brought to the same elevation before any jacking was started on the next increment. The entire lift of 17 ft., including the pouring of the concrete pier extensions, was completed in 24 eight-hour working days.

At the request of the Alabama

Fig. 7. Steel beam spans, 80 ft. long and weighing 150 tons, were held in raised position by the gantry while structural steel extensions were added to the concrete tower bents.

state highway engineer the specifications required that the contractor weigh off the truss reactions at the end bearings as a check on the setting of the bearings to the proper relative elevations. This weighing operation, which was done with the aid of gages on the hydraulic jacks, showed that the reactions would more nearly agree with those used in the original design if the bearings at the intermediate piers were raised two inches more than those of the end piers; the completed work includes this indicated adjustment.

It was obvious that to keep within or reduce the 100-day period allowed for keeping the bridge closed to traffic the critical operation was not that of raising the river bridge, but the construction of the new substructure for the pile bent section of the south approach. As an aid to speeding up this part of the work the contractor conceived the brilliant idea of picking up each span with a gantry crane that could straddle the bridge on movable tracks at the ground level, turn the span 90 deg. in a horizontal plane and lower it to the ground between its supports where it could rest while the new substructure was built. Since the length of each span was 36½ ft., and the overall width only about 24 ft., a clear working space of about 12 ft. was available. By this method the cost of falsework could be eliminated for all but a few special spans. After the completion of the new substructure, the gantry could return and replace the spans on their new bearings.

The method was approved and a gantry was designed with a height of 80 ft. and a span of 55 ft. It consisted of two separate portals spaced 36 ft. apart by three lines of struts placed near the base, at midheight and at the top. An inverted kingpost truss at the top of each portal was pin-connected to each leg at the top and was knee-braced to only one leg, an arrangement that avoided indeterminate stresses arising from any inequality in the elevations of the supports. At the bottom of each leg the load was transmitted through a pin connection to a brass-shod skid which slid in two inverted steel channels mounted on heavy timber rails. The track was in short sections so that it could be shifted ahead as the gantry was moved.

Hoisting arrangement

On each portal there was an 80-ton hoist operated by an electric motor, with "stop" and "go" push-button control. The hoisting cable ran from the drum to the top of the gantry and thence through a 15-part falls, so reeved as to minimize the effort required to turn the spans through 90 deg. The lower pulley supported an equalizer block through which passed four cables leading down to the corners of a steel spreader placed a few inches above the roadway deck. From the corners of this spreader four short links passed through small holes cut in the roadway slab. Each link supported a steel saddle which picked up the load through a bearing under each of the adjacent beams. Thus each of the four beams in each span was supported at a bearing near each end while the span was being raised or lowered. Wood blocks and wedges were used to equalize the bearing.

The scheme of laying the spans on the ground between the bents offered the opportunity to redrive the existing concrete piles before cutting them off and inclosing them in the new footings. After removing the concrete caps, therefore, the four piles in each bent were driven to a resistance of 40 tons, which they apparently withstood without injury. It was found that some of the piles could be driven as much as 16 ft. before developing the required resistance. Following this operation, the footings were built, incorporating the new cast-in-place piles and the redriven piles, and the new two-column bents constructed.

While these new bents were being built, the gantry proceeded toward the river raising the long steel beam spans in the tower bent section. Since these spans could not be turned 90 deg. and lowered to the ground, the gantry held them up while the tower extensions were added. These structural steel tower extensions were hung from the bottom of each span before it was raised and so were ready to be set in place as soon as the span was in position. Since the structural steel supports were designed to carry full dead, live and wind loads, no effort was made to pour the concrete incasement while the bridge was closed to traffic. This operation was left as one of the last in the contract.

Having completed the raising of all of the tower bent spans the gantry moved back toward the south end of the bridge and started replacing the T-beam spans on their new two-column bent supports. As fast as the spans were reset the holes in the deck were patched and the railing posts, which had been removed were replaced.

The bridge was reopened to traffic after having been closed about 71 days, 29 days less than the allowed period of time, which gave the contractor an earned bonus of $5,800. The shortened construction period permitted the termination of the ferry contract 29 days earlier with a direct saving to the TVA of $5,992, besides the saving on maintenance of the ferry approaches.

When the bridge was reopened to traffic little remained to be done ex-

cept to pour the concrete incasement around the structural supports on the two-column bents over the creek and on the tower bents adjacent to the main bridge. This proved to be a long and tedious operation owing to the small clearance of the forms around the structural steel and the height of the forms above the ground.

T. B. Parker is chief engineer of the Tennessee Valley Authority, H. A. Hageman, chief design engineer and F. W. Webster is highway engineer in charge of all highway and railroad adjustments. The writer is in direct charge of all the highway bridge design and remodeling. W. N. Downey, associate structural engineer handled the design of this project and S. L. Breeden, associate highway engineer, supervised the construction as resident engineer.

Septic Tanks and Short Courses Trouble Public Health Engineers

Contents in Brief—State sanitary engineers and college professors took the spotlight in discussions on engineering problems at the annual meeting of the American Public Health Association. Paul Hansen, consulting engineer, Chicago, prepared the following notes on the technical sessions.

SEPTIC TANK DESIGN, short course training methods, and water supply research were among the topics of interest to sanitary engineers discussed at the meeting of the American Public Health Association in Pittsburgh, Oct. 17-20. Attendance at the meeting was marked by the presence of many state sanitary engineers, a goodly number of teachers, and the comparative lack of representation of engineers in private practice.

In a discussion of regulations controlling the size of septic tanks for individual houses and small institutions, the general conclusion was reached that a suitable basis of design was 50 gal. per capita per day. There was a wide variation in the minimum capacity; some states allow as little as 250 gal. while others require as much as 500 gal. The National Park Service requires a minimum of 750 gal. Wooden tanks were recommended for places that are not easily accessible, as these can be shipped knocked down and can be quickly erected. Such tanks will last five or six years.

There was complaint that rules relative to small sewage treatment installations were copied from one state to another and none had a sufficient basis of actual tests. This brought out the fact that the University of Illinois had made tests on small septic tanks, and Arthur D. Weston, chief engineer, Massachusetts state department of health, said that tests are under way on two small tanks at the Lawrence Testing Station. One of these receives sewage from the station only, and one receives the Lawrence city sewage. Results are not yet available.

Short courses: Pro and con

In a discussion on training of waterworks operators, Prof. Gordon M. Fair, Harvard University, opposed schools for short course training of operators, particularly if a certificate is given as evidence of attendance. It was claimed that this gives an entirely false idea of the capacity of the certificate holder, is an imposition on the public, and defeats progress towards placing men with good technical training in charge of water and sewage treatment plants. The other side of the question, presented by A. F. Dappert, sanitary engineer of the New York State department of health, held the general view that the first consideration was obtaining good operation of water and sewage treatment plants as quickly as possible. He pointed out that it is impossible to secure the appointment of technically trained men in the smaller cities and that the next best thing is to take the men actually in these positions and give them training. It was pointed out that this policy had not defeated the movement to place technically trained men in such positions. On the contrary, it had developed an appreciation of technical knowledge and that the number of trained operators is constantly increasing. He also maintained that the program does not have to be carried out on a basis that will lead to a false idea of what a short course can accomplish.

Prof. F. M. Dawson, dean of engineering, University of Iowa, outlined the activities of the National Plumbing Laboratory at the university. While this laboratory is supported by master plumbers, it is represented by a board of direction that has no financial interest in the manufacture of fixtures or plumbing materials. Before the laboratory examines a plumbing fixture as to its sanitary correctness, it must actually be on the market. The fixture may be examined at the request of any local public health authority, or at the request of the manufacturers.

Water pollution control

Governmental policy on stream pollution abatement was discussed by Prof. H. G. Baity, of the University of North Carolina. He advocated that the study and control of interstate streams and their tributaries should be placed under the U. S. Public Health Service, operating in collaboration with state departments of health, and that where sewage treatment along such streams is desirable, there should be available federal grants-in-aid.

Developments in the water supply research program of the U. S. Public Health Service were described by J. K. Hoskins, sanitary engineer in charge at Cincinnati. Field studies in the drainage area of the Ohio River are actively under way. Among the investigations is a laboratory study on a pure culture of zoogleaforming bacteria which, when grown in a sterile synthetic sewage, developed the characteristic flocculation of activated sludge.

The relationship of stream pollution abatement to Pittsburgh's water supply and health was outlined by Chester F. Drake, engineer of water purification. Typhoid and enteritis statistics were presented to show that there is no water-borne disease in Pittsburgh.

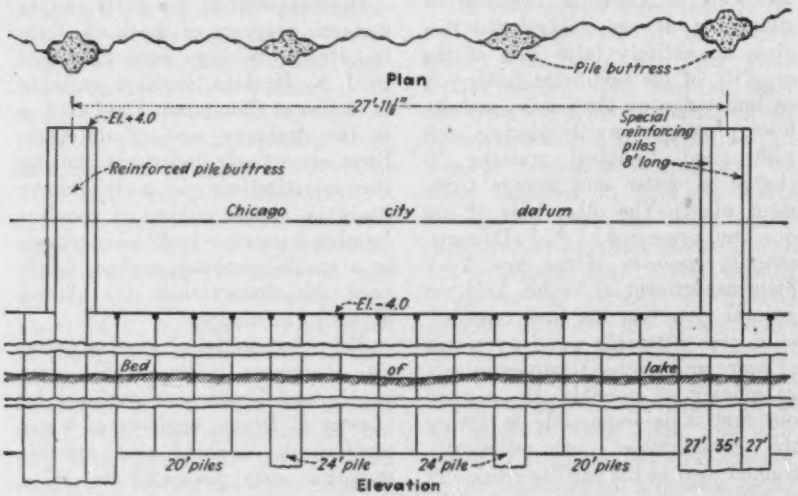
Underwater Seawall Widens Chicago Beach

Contents in Brief—Ends of seaward jetties on the Lincoln Park lakefront connected by underwater sheetpile wall to form pockets for a new sandfill.

A PARTLY SUBMERGED BULKHEAD to check the sweep of storm waves is the somewhat novel type of structure adopted to protect the lakefront of Lincoln Park, at Chicago, and also to permit the forming of a long stretch of bathing beach as the shore line. A single line of steel sheetpiles reinforced by clusters of buttress piles is used, with its top 4 ft. below city datum. A similar structure was built in 1926 at the Northerly Island, opposite the end of 14th St., and has proved successful; but that work, having its top 2½ ft. below datum, consists of a double row of wood piles with rock filling. The actual water level of the lake has ranged from 2 ft. above to 2 ft. below the city datum in a period of 50 years.

That part of Lincoln Park now being protected is exposed to severe storms from the northeast, and in 1930, after extensive damage had been done by storms of 1929, six jetties were built, about 500 ft. long and 600 ft. apart, at an angle of 70 deg. from the shore line. It was expected that sand would be deposited between the jetties as a protective beach. To increase this action by checking the currents, each jetty had a short spur on the rear or lee side, near its outer end. However, with the limited littoral current, the expected action did not take place and the jetties have sustained considerable damage from the waves. They consist of double rows of wood piles about 6 ft. apart, with loose rock filling which is capped by massive quarry blocks laid at random to form a rough irregular surface.

The new structure, 500 ft. from the shore line, and in 15 ft. of water, connects the outer ends of the old jetties and with them forms cells or compartments 500x600 ft. The plan is to pump in sand for a beach about 300 ft. wide, but the slope and width of sand and its contour at the water's edge will depend upon the rather uncertain action of the lake waves. Three cells were filled in 1938, and in these, as well as at the Northerly Island beach, the sand takes a slope of about 1 on 32. The first or south jetty has been rebuilt and extended as a solid pier 2,000 ft. long, curved in plan and with a hooked outer end designed to retain drifting sand. From the side of this pier the submerged bulkhead extends north, practically parallel with the shore as it now exists.



Typical panel of submerged bulkhead wall that is building the widened beaches of Chicago's famous north shore park.

As shown by the drawing the submerged wall consists of a single line of interlocking steel sheetpiles 20 ft. long (24 ft. for every sixth pile). At intervals of 28 ft. there are buttresses composed of four sheetpiles interlocked and two half-piles riveted on to form a hollow cluster. These hollow pile clusters are filled with concrete deposited by tremies. All the piling has its top 4 ft. below datum, except that the buttress piles extend 4 ft. above datum to mark the line of the wall and also to assist in breaking up the sweep of the waves. In addition to the tall buttress piles, there are in each 28-ft. panel two somewhat similar concrete-filled pile buttresses of the same height as the line of submerged sheeting. There is no waling on the sheetpiling.

To break up waves that run diagonally to the shore line, to prevent erosion along the outer face of the submerged bulkhead and to divert sand in suspension into the enclosed cells, spurs 72 ft. long and 200 to 300 ft. apart, extend outward at an angle of 45 deg. from the line of the bulkhead sheeting. Steel sheetpiling is used also for these jetties, but three 28-ft. piles with their tops 4 ft. below datum alternate with buttresses of 40-ft. piles having their tops 3 ft. above datum. At the end of each spur jetty is a dolphin 4 ft. 8 in. in diameter, composed of twelve interlocking piles 40 ft. long and also extending 3 ft. above datum. This shell is filled with concrete, and in its alternate piles the web is bent to a convex curve, so as to form vertical corrugations in the shell.

For the long curved pier from which the line of bulkhead sheeting starts, there are two rows of steel sheetpiles 40 ft. long spaced 13 ft. 7 in. apart and tied together at the top (5 ft. above datum) and at datum by 1½-in. tie rods 6½ ft. apart. Each row of piles has one line of inside waling, composed of a pair of 8-in. channels with webs horizontal and back to back. Transverse diaphragms at intervals of 100 ft. are composed of single lines of sheeting with an 8-in. channel on each side as a wale, having its web vertical. Gravel is filled in to within a few inches from the tops of the piles and is capped with a 24-in. reinforced-concrete slab 14 ft. 9 in. wide, having expansion joints at intervals of 30 ft.

In the plans now adopted for an

extension northward of the breakwater, two changes have been made. The top of the submerged piling is to be 3 ft. instead of 4 ft. below datum line, and the 72-ft. spur jetties on the face are to be omitted temporarily, although provision is made for placing them later if found desirable. It appears that in the work already built these spurs have not been of any special value. The sand filling for the beach was placed with a slope down to 5 ft. below datum against the bulkhead but as the waves have lowered this to 8 ft., the new sand filling in the extension will be kept down to the latter level. No contracts have been let as yet for this part of the work.

This shore protection work, for the Chicago Park District, was designed and built under the direction of R. H. Burke, chief engineer (now chief engineer for the new rapid-transit subway); Linn White, consulting engineer for the district, and G. T. Donoghue, general superintendent. Contractors for the steel pile construction work were the Warren Construction Co. and the FitzSimons & Connell Dredge & Dock Co., while the latter concern and the Great Lakes Dredge & Dock Co. had contracts for the sand filling required to form the new beach.

Lead Seal for Tainter Gates

O. N. Floyd
Consulting Engineer, Dallas, Tex.

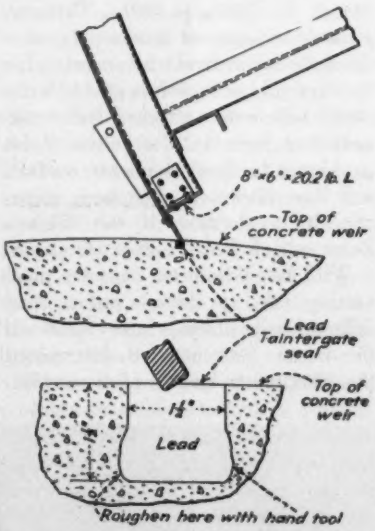
In most cases the seal specified and furnished for the bottom of a Tainter gate on the crest of a spillway is a 6x8-in., or larger timber, usually whiteoak, bolted to the bottom member of the gate and shaped so as to form an even bearing on the top of the concrete weir or sill. Long experience with this type of seal on a large number of Tainter gates in the southwest where water stages are quite variable and the water generally is hard on paint and steel, has disclosed the following rather serious defects or objections:

1. Proper timbers are expensive and hard to obtain. This is especially true where only a few at a time are needed for renewals.

2. In opening and closing the gates the bottom of the timber seal is often badly damaged by logs or smaller driftwood so that ugly sprays or leaks occur under the gate.

3. When the water in the reservoir falls below the bottom of the Tainter gates, these seal timbers dry out and warp and crack.

4. It is practically impossible to keep the water from penetrating between the timber and the steel to which it is fastened and causing decay of the wood and the rusting of the steel. This also applies to the contact between the rubber side seals and the end of the timber seal.



Bottom seals for the Tainter gates for the Red Bluff Dam spillway near Pecos, Tex., are a lead-filled slot in the crest concrete.

5. Generally, within ten years from the time of the initial installation, at least one-third of the timbers will have been renewed and all will need to be renewed in fifteen to eighteen years.

Hoping to avoid most of the above-mentioned troubles, the writer specified and had installed for the Tainter gates on the Red Bluff Dam spillway near Pecos, Tex., a lead seal as shown on the accompanying sketch. There are twelve of these gates, each 15 ft. high by 25 ft. wide. The work was completed in the fall of 1936 and in about six months the reservoir filled to the top of the gates and remained almost full for about fifteen months. The water is now below the bottom of the gates. At no time while the water remained against the gates was there ever a trickle of water under the bottom of any of the gates. At one time it was necessary over a period of about two weeks to open and close part of the gates several times to discharge excess floodwaters but the seals were always perfect when the gates were closed.

Obviously it was necessary to support the form rigidly for the groove in the concrete while the top of the weir was being placed. After the form had been removed the bottoms of the sides of the groove were roughened and slightly undercut with a hand chisel to provide a better bond between the lead and the concrete.

Ordinary lead used

Ordinary pig lead was used such as is used for the joints of cast-iron pipe. The lead was poured after the gates had been installed and the lifting chains properly adjusted. The gate was lowered so that the upstream bottom edge of the steel angle would extend about ½ in. below the top surface of the finished lead strip. The first cost of the lead was about the same as for 6x8-in. oak timbers, and the cost of pouring the lead was less than one-tenth of former costs for fitting, installing and painting the timbers. So far there is nothing to indicate that the lead strips will ever require any maintenance or need to be renewed.

The contact member on the bottom of the gate may be an angle or other shape that best meets the structural requirements, but to have room for pouring the lead and an opportunity to observe the work, this contact edge should extend at least 3 in. below the row of rivets in the bottom of the skin plate.

Each of these gates weighs about 33,000 lb., most of which rests on the bottom seal. With full contact of the edge of the $\frac{7}{16}$-in. angle the unit pressure on the lead would be about 200 lb. per sq. in. As actually poured the unit pressure is probably 400 lb. per sq. in.

The City's Sewage Goes to Sea—II

N. A. Bowers

Pacific Coast Editor, Engineering News-Record

Contents in Brief—This is the second article in a series summarizing experiences with subaqueous outfall sewers. It describes design and construction features. The first article (ENR, Nov. 26, 1939, p. 689) dealt with the function and types of existing installations. The final installment in a coming issue will be devoted to operation and maintenance.

Joints between sections of pipe in an outfall appear so frequently in the list of troubles as to make them easily the most vulnerable part of the installation. Based on a study of outfall joint failures, an article published in *Engineering News-Record*, Aug. 25, 1927, p. 294, presented data on various types of joints that had been used up to that time; details were given for six notable joint types. Difficulty with joints has been experienced mainly in the larger diameter outfalls because in the smaller diameters the joints can be made as strong as the pipe itself. Moreover, in pipes of the smaller diameters (18 in. and less) the sections are longer and thus fewer joints are required. In some instances the entire length of a small-diameter outfall is put together with welded joints which have a strength equal to the adjoining metal.

When outfall diameters must be of the order of 20 in. or more, common practice has been to use some form of slip-joint such as the bell-and-spigot or the more costly ball-and-socket type. The joints ordinarily have been made of the same material used in the pipe itself. At least this was true until the advent of the White's Point outfall (California), which introduced the novel combination of a reinforced concrete pipe barrel (5-ft. inside diameter) with a cast iron joint of the ball-and-socket type (*ENR*, March 11, 1937, p. 369). This has evoked widespread interest because the material in modern concrete pipe is commonly accepted as able to withstand salt water attacks; the weakness has been in the joints. Joint problems in large-diameter outfalls will have been solved in large measure, it is claimed, if the White's Point outfall bears out expectations.

With large-diameter concrete pipe, casting yard problems rather than difficulties in placing heavy units on the ocean bottom have determined the maximum length of a section. About 14 or 16 ft. is a practical length limit for individual sections of 6 or 7-ft. diameters. As an example of weights: each 18-ft. length of the 5-ft. White's Point outfall weighed about 18 tons.

Kinds of joints

The weight limitation in manufacture has resulted in using two types of joints; one suitable for convenient assembly on shore and one for assembly by diver. The former is used for connecting up, in the dry, as many lengths as can be launched and laid simultaneously; then the only joints to be made under water are those at intervals of several sections. For these submarine joints it may not be too costly to use the ball-and-socket type.

"Whether the diameter is large or small," said an engineer of broad experience with subaqueous sewers, "there is need for a flexible joint at intervals of 5 to 10 sections. Such joints take up the vertical and horizontal movement in the line (particularly apt to occur near the shore) and reduce the tendency to pull apart the rigid joints or partially to open them up on top, bottom or sides."

For joints that must be completed on the bottom, the preference is for

An 8-in. pipe (welded joints) was pulled into the sea at Carpinteria, Calif., by a tug using shore targets to keep on line. The pipe was pulled along the bottom for 3,000 ft., its outer end attached to a heavy timber sled (right) faced with steel plates.

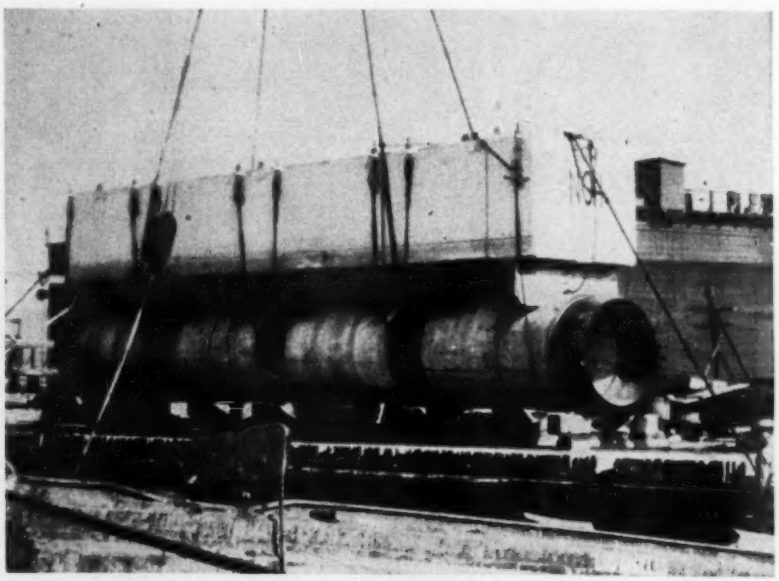
a type that permits calking (and any other operations necessary after placement) to be done by the diver working *inside* the pipe. After a section is in its final location it is much easier to work on the joint from the inside than from the outside. On the inside the diver is not swayed about by the wash of waves hence work can be done more quickly and effectively; work done inside does not entail cutting into the foundation to make bell holes. An adequate foundation should be left undisturbed, say experienced constructors; if settlement occurs on an outfall calked from the inside, further calking can make the line tight again without disturbing foundation or backfill.

If a joint design involves mastic or plastic material, a point worth noting is the temperature effect of the relatively warm sewage upon this material. (It has been suggested that because this risk does not obtain in subaqueous pipes carrying water supply there has been a tendency to overlook it in the design of outfall sewers.) Sewage temperatures may be high enough to soften such a compound, weaken the bond and permit the pulsation of wave action eventually to work the mastic loose and open the joint. Instances of serious damage from this cause are on record.

Outlet structures

Much importance has been attached to the design of the outer end of outfall sewers, particularly where maximum dispersion must be obtained in relatively shallow water. The simplest form of terminal is merely the open end of the pipe; if nothing more is done the end usually is turned upward, either to avoid too-easy entrance of sand moving along the bottom or to provide storage space adjoining the terminus for such solids or accumulations as tend to sink to the bottom in a location where there are no currents.

Openings in the top of the pipe sometimes are put in near the outer end of an outfall to supplement flow through the open end. Sometimes the end of the line may be divided into two or more outlets discharging in different directions, perhaps with their ends some distance apart for better dispersion. If the line is divided at the outer end the branches are made short and care is taken to make sure that each branch will carry the same flow. Otherwise, experience indicates, the longer branch is likely to clog with grease or sand or both. The depth of two or more pipe ends, good practice suggests, should also be equal for similar reasons.



Ready to launch four 12-ft. sections of pipe attached to a supporting pontoon for the mile-long ocean outfall near Los Angeles.

An example of trouble at the pipe end is afforded by the Los Angeles outfall at Hyperion. The original design called for a wye terminal to provide two points of discharge. When the line was being built a storm prevented completing one leg of the wye and the job never was finished. Hence, the major portion of sewage flow, even at the start, discharged through the shorter leg of the wye. The longer leg soon clogged up and has remained closed.

Where the most effective diffusion possible must be obtained, a diffuser cap has been found to have advantages over discharging from the open pipe end. A comprehensive discussion of diffusers by A. M. Rawn and H. K. Palmer was published in Am. Soc. C. E. *Transactions*, 1930, p. 1,036. In this paper is worked out the relation of depth to volume of flow as modified by ocean currents and velocity of sewage discharge. Application of the formulas there developed resulted in a diffuser resembling a splitter cone (such as is used with hydraulic turbines but mounted in an inverted position) and equipped with vertical vanes on the lower side. Such a device on an outfall in Long Beach harbor has been highly effective in producing the desired dispersion of the sewage.

The critical portion of most ocean outfalls, designers agree, is in the zone where waves break. Preferred construction puts this part of the line in a trench cut in rock and backfilled with concrete. Seaward from the breaker line, however, preference generally is for a line simply laid on the ocean bottom. Where the bottom is fairly uniform in slope and has a smooth surface, dependence is placed upon the weight and inherent rigidity of an outfall of large diameter to hold it in place. In the light of recent experience it is believed that there is more likelihood of satisfactory operation if the outfall beyond the breakers is neither buried nor elevated.

There are objections to putting the line in a trench and backfilling with sand or to elevating it above the bottom on a trestle support. The trenching operation involves excavation which is difficult to finish off smoothly. Laying pipe on an uneven bottom has been the cause of serious joint troubles. Moreover, sand backfill around a pipe laid in trench introduces the serious risk that if joints should open slightly sand may be sucked in by the pulsations of wave action.

Conditions along the outer portions of outfalls that have been observed for many years support the belief that burying is not necessary beyond the breakers. Bags filled with concrete and other objects have remained on the bottom undisturbed, just as they were left when the out-

Wrought iron outfall sewer supported on a timber trestle at Asbury Park, N. J. This 24-in. line extends 1,055 ft. into the ocean; the joints were welded at 20-ft. sections and every third joint was reinforced with wrought iron sleeves welded in place.

fall was built years before. Similar indications come from the vicinity of the discharge end; in some cases thick deposits of sludge have remained for long periods around the end of the line. These indications would be absent, of course, and quite contrary requirements would obtain where strong ocean currents or wave action caused shifting of the bottom.

In large-diameter outfalls, because joints are the weakest parts of the line, any interruption to uniform line or grade is regarded as liable to subject joints to stresses beyond the designed load and perhaps beyond their ultimate strength. This has led to the use of trestle supports, where bottom conditions were adverse, in an attempt to provide a foundation at desired line and grade more accurately than otherwise would be feasible.

Where currents are swift, and there is danger of shifting bottom, this risk has sometimes led to the use of trestles as a safer design. However, when placed on a trestle, the outfall offers greater collision hazard and any cross-currents work with the advantage of a leverage not operative when the pipe is laid on the bottom.

Where a trestle is used, question has been raised as to whether it should be made of wood or steel. If damaged by collision, or by a dragging anchor, a timber trestle may be expected to fail at one point, that is, to confine breakage to the immediate zone involved. A collision involving a steel trestle on the California coast caused steel stringer construction to pull out several more bents than were involved in similar damage to a timber trestle of the same size and height. Conclusions on comparative merits are indicated by the fact that the steel trestle bents were replaced with timber construction.

Two methods of anchorage used for the metal pipe outfalls of smaller diameter are chains and concrete piers. Where chains are used the common method is to bolt collars around the pipe at 50 to 100-ft. intervals to which are attached lengths of old iron chains laid out on the bottom at right angles to the pipe. A length of about 25 ft. on each side of the pipe has been common in such cases. The weight of the chains soon embeds them far enough to give the outfall resistance to transverse movement.

On hard bottom, for pipe of large diameter or where anchorage is necessary for pipe of any diameter by reason of ocean currents, a preferred method of anchorage is the use of concrete piers, either poured in forms or placed in sacks piled up around the pipe. In such anchor piles, each sack is slit open after being placed.

Subaqueous outfalls of small diameter (18 in. or less) ordinarily are constructed on shore and then placed in one operation, either by pulling the line along the ocean bottom or by launching it, towing it to place and there sinking it bodily. A preferred method is first to construct an inclined slide or runway on the beach on which the pipe sections are assembled and the joints are made tight. If to be floated, the line may have sufficient buoyancy of itself, with the ends closed, or floats may be added. Construction by this method concentrates risk on the placement operation: wind, rough water or currents can seriously interfere. There is the advantage, however, that when joints are made in the dry better work can be done and thorough inspection is possible.

Outfall pipe of 16-in. diameter or less frequently has a coating of shotcrete, put on over a wrapping of wire mesh, after the joints have been finished and just before the line is placed. The additional weight and protection thus afforded is regarded as a decided advantage provided the line can be placed without injury to the protective coating.

Placement of outfall pipe sections of the larger diameters ordinarily is by one of two methods: either the sections are lowered to place from trestle or derrick barge, or they are placed with the aid of pontoons. In the latter method the pontoon, with pipe sections attached to its under side, is towed into position and water is there admitted until the assembly sinks to the bottom. There the pipe is released from the pontoon, compressed air is admitted to expel the water and the pontoon returns to the surface.

To provide better control in the lowering a derrick barge sometimes is used in conjunction with the pontoon. Under this plan only enough water is let in to give the assembly slight negative buoyancy. Then, with a relatively light load on the derrick barge, the lowering operation is under control: if first placement is not entirely satisfactory the section can be raised slightly or moved about as the diver directs.

The final installment of this series will appear in the Dec. 21 issue. It deals with operation and maintenance methods, and will include a tabulation of the characteristics and cost of major sewer outfalls.

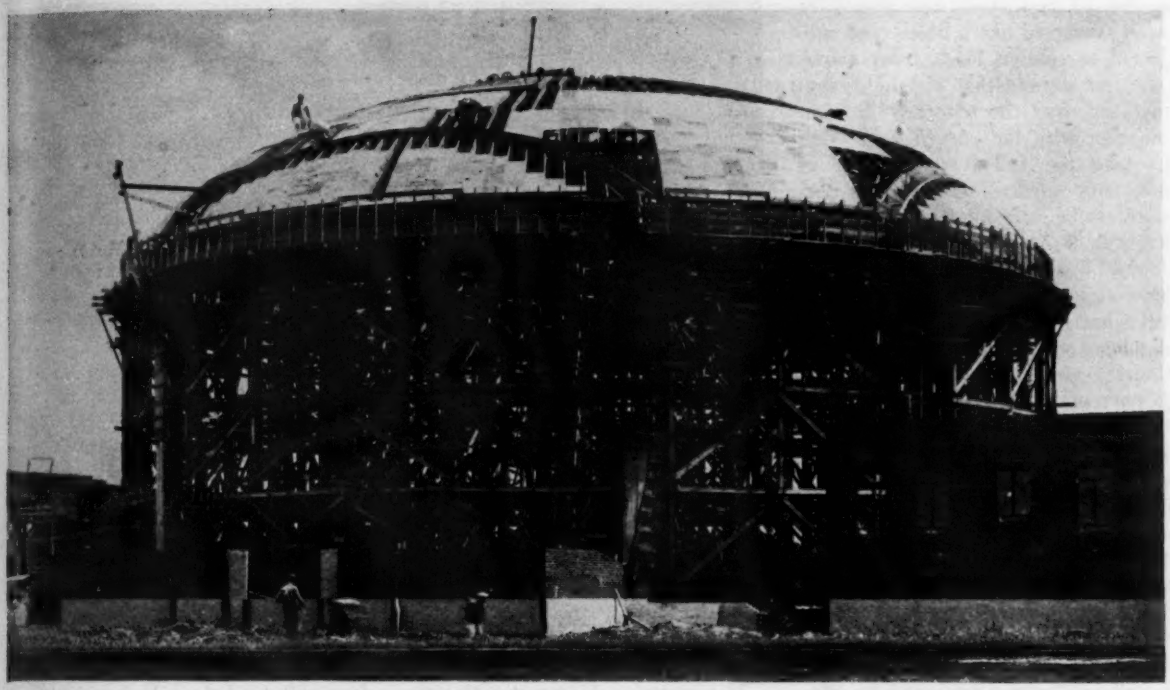


FIG. 1. FORMWORK AND CENTERING FOR DOME. CURVED TROUGHS ARE FORMS FOR DIAPHRAGM MEMBERS.

Point-Supported Dome of Thin Shell Type

ANTON TEDESKO

Engineer of Structural Design, Roberts and Schaefer Co., Chicago, Ill.

Contents in Brief—The largest span point-supported concrete dome in America, 110-ft. diameter, was recently erected over a new auditorium at Tulane University, New Orleans. Of thin curved slab type, necessary stiffening at the springline is provided by a polygonal set of diaphragms rather than by a circular ring girder which, although used on this dome, is made flexible in horizontal direction.

THE NEW McALISTER AUDITORIUM at Tulane University, New Orleans, consists of a 110-ft.-diameter circular central unit accommodating the main floor portion of the auditorium and bordered by structures of rectangular plan incorporating the stage, side wings and balconies. The roof of the center hall—for which the outside appearance of an elliptical dome was required—could not be supported continuously along its circular base ring, since the number of columns was restricted by a plan layout that required a minimum column spacing of 54 ft. for the stage and balcony openings. A conventional dome could have been used, supported on steel trusses or girders and beams, but H. Mortimer Favrot, the architect, decided to use a monolithic concrete dome whose thin curved slab provides the "girders" to support itself as well as suspended loads for projector rooms, ventilator ducts, tile, fixtures, adjoining roofs, etc.

Thin curved slabs when properly shaped have excellent structural properties provided they are rigidly held in position by some suitable device. Fig. 2, showing details of the McAlister Auditorium dome, indicates how polygonal diaphragms have been adapted to this purpose. A horizontal stiffening of the springing line along the base ring circle by connecting the dome to the side wing roofs would have made the dome capable of girder action without the insertion of polygonal members, but since these roofs could not be placed on elevations desirable for stiffening purposes and since other means of ring stiffening seemed costly, the insertion of the polygonal members was found desirable.

Design Procedure

It has been shown that for the calculation of dead load stresses of an elliptical dome over a circular area, an affine hemispherical dome may be substituted so long as weights per unit of projected plan area are the same in either case. Consequently, preliminary calculations were based on a substituted spherical dome.

Since loads had to be suspended along lines *AA* (Fig. 2) a polygonal member or diaphragm was placed along each of these lines. To determine whether such diaphragms rather than the base ring girder if properly stiffened would cooperate with the shell in carrying loads, a rubber

model of the dome was placed in sand (reversed like a bowl) and subjected to column loads from above. The test showed that the diaphragm members had the tendency in combination with the curved dome slab to take the full load as long as the ring girders along lines *BB* were sufficiently flexible to move horizontally and thus unload themselves. When the ring girders were held rigidly, it was not possible to tell what percentage of the load the diaphragms carried. Consequently, the ring girders were made stiff only in portions *CC*, where they fully participate in the carrying action, and very flexible in portions *BB*. The diaphragms with the dome slab were then calculated to take 100 per cent of the load by an action somewhat comparable to the bending action of a T-beam with a curved flange, the diaphragm member being the stem and the curved dome shell the flange.

Detail calculations were made for a polygonal dome stiffened by diaphragms and for a point-supported circular dome. The ring girder was provided with haunches at the columns to ease the great stress concentrations above column supports of a point-supported dome. The results of the detail calculations for both systems were combined, and the stress lines in the dome and forces in the rings determined accordingly. The resulting structure is a combination of a polygonal and of a circular point-supported dome, portions of which act like girders in space from which loads are suspended. The curved lines along which the reinforcing is placed (Fig. 3) are the results of the detail stress analysis.

Fig. 3. Reinforcing of dome is arranged in direction of principal stresses. Concrete has been placed in diaphragm member at center of view.

The centering for constructing the dome, consisting of light timber sections, was also used as a working platform for finishing the interior of the auditorium hall. Concrete of a rather stiff mix was used for the roof. It was raised by a hoisting tower, distributed by buggies along circular runways and chuted into place. No top forms were used. The dome received a nailcrete finish, on which the roofing was applied. The decentering of the dome revealed a vertical downward deflection of the crown on the order of 1/16 in., indicating close agreement with design calculations.

Favrot & Reed, New Orleans, were the architects for the structure, which is a gift to Tulane University from Mrs. Amelie McAlister Upshur in memory of her mother, Mrs. Armantine Reynaud McAlister. Roberts and Schaefer Co., Chicago, were the consulting engineers for the Z-D dome, believed to be the widest span point-supported cupola in America and exceeded in span only by a dome in Algeciras. The contractor was Gervais F. Favrot, New Orleans. The structure was built under a license from Structural Shell Designers, Inc., Chicago.

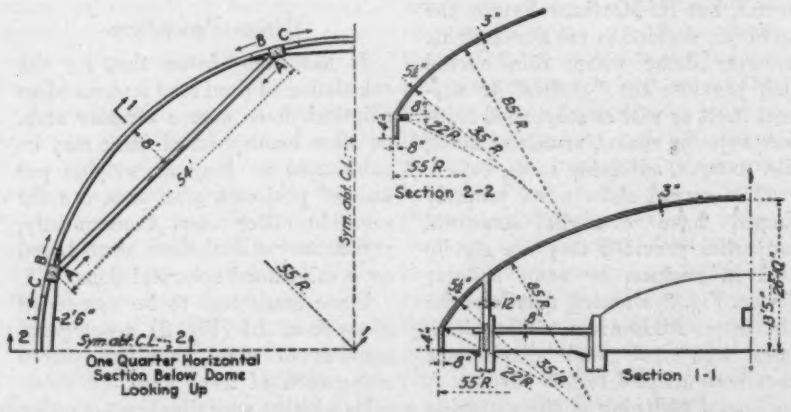


Fig. 2. Structural details of 110-ft.-diameter concrete dome of thin curved slab type. Stiffening at springline is provided by four diaphragms, *AA*, spanning between columns on 54-ft. centers and by that part of the ring girder marked *CC*.

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Civil Service Agency Trains Local Officials

In an effort to improve merit systems of the local governments, the New York State Department of Civil Service recently established one-day "training schools" to instruct municipal officials in the technical aspects of personnel administration, according to the Civil Service Assembly of the United States and Canada.

The training sessions, to be held at various times of the year on a "circuit rider" plan, are a cooperative project of the state civil service department, the New York State Conference of Mayors, the New York State Department of Education, and the Bureau of Public Service Training. New York is one of the few states which provide for aid to local governments on civil service matters.

Soil Tests Check Chicago Subway Work

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Engineer in Charge of Soil Investigations
Department of Subways and Traction, Chicago, Ill.

Contents in Brief—Soil variation on Chicago subway tunnels prompted elaborate subsoil exploration programs. Bore-hole samples taken every 300 ft. for laboratory tests. Ground resettlement profiles determined daily. Pressure sections of tunnel and pressure cells incorporated in the work for long-time soil-pressure observations.

UNDERGROUND EXPLORATION both in advance of construction and as excavation proceeds is a definite part of the engineering service in building the Chicago Subway. Underlying all the 40,000 ft. of tunnel line is the thick mass of glacial clay that has made Chicago foundation processes widely known. This clay varies greatly in the load carrying ability; in many places it is soft with a tendency to flow toward an excavation. To know of these variations in advance and to watch their effects on holding the tunnel bore and on adjacent building foundations were felt to warrant a planned schedule of observations. In accordance with this decision, a soils laboratory was established.

Sampling and testing

A series of exploratory borings was made the entire length of the proposed routes. The borings were spaced at about 300-ft. intervals and were carried to a depth of 10 ft. below the bottom of the tunnels. Throughout the clay layer, samples were taken in 2-in. steel tubes in such a way as to obtain a continuous core for each boring. The samples were recovered at their true natural water content and in a partially remolded state.

To take a sample, the bore hole was cased and washed clean down to the elevation of the bottom of the last sample. A 3-ft. length of 16-gage tube, sharpened at the lower edge, was then affixed to the bottom of the drill rod and pushed into the ground under a static load for a distance of 2½ ft. During this process, a simple field test for the consistency of the soil was made, consisting of the measurement of the static load and the time necessary to produce a penetration of 1 ft. From these data was computed the "penetration resistance," defined as the weight necessary to produce a penetration of 1 ft, in 1 min. This quantity, although based on a rough field test and simple assumptions for computation, was found to have a reasonable correlation with the compressive strength determined from the same soil samples later in the laboratory.

Treatment of samples

After the samples were removed from the holes, they were carefully sealed in the tubes and removed to the humid room of the laboratory for testing. In preparation for testing, the tubes containing the samples were cut into 6-in. lengths and each 6-in. sample was removed from its tube. For each of these individual cylinders the natural water content was determined, and on selected borings, the liquid and plastic limits. On one sample out of every five, representing a vertical spacing in the ground of 2½ ft. the unconfined compressive strength was also determined. From the appearance of the samples at the time of testing, a verbal description was made, and together with the test results recorded on a boring data sheet, as shown in Fig. 1.

The natural water content and the unconfined compressive strength were considered to be the most useful values from which the stiffness of the soil could be predicted. Therefore, these were plotted from the individual boring data sheets in the form of profiles, as shown in Fig. 2. These profiles represent the quantitative data, obtained from standard laboratory tests, from which the engineer can, in the light of his judgment and experience, form an opinion as to the probable behavior of the soil.

Settlement and pressure studies

During construction, samples for natural water content and unconfined compression tests are taken daily

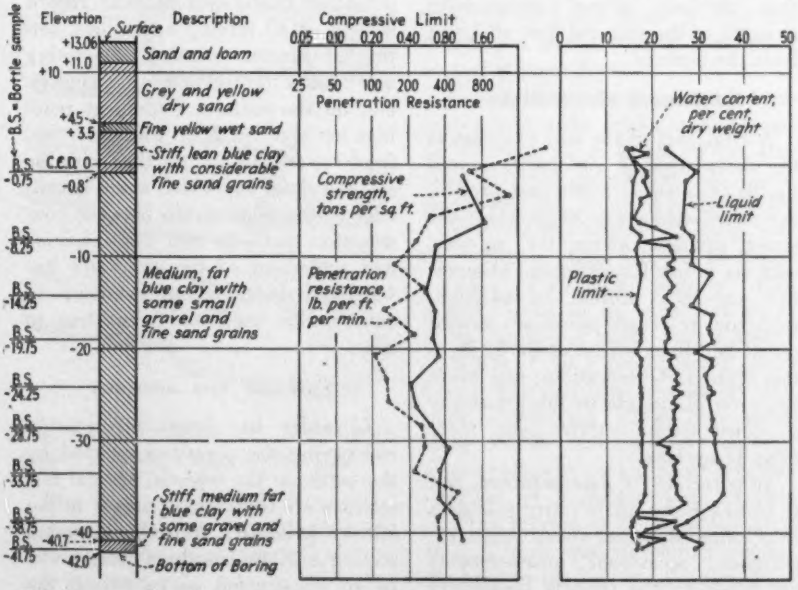


Fig. 1. Boring data sheet records in this form give bore-hole and laboratory test results for all bore-holes, which are spaced 300 ft. apart on 40,000 ft. of Chicago subway.

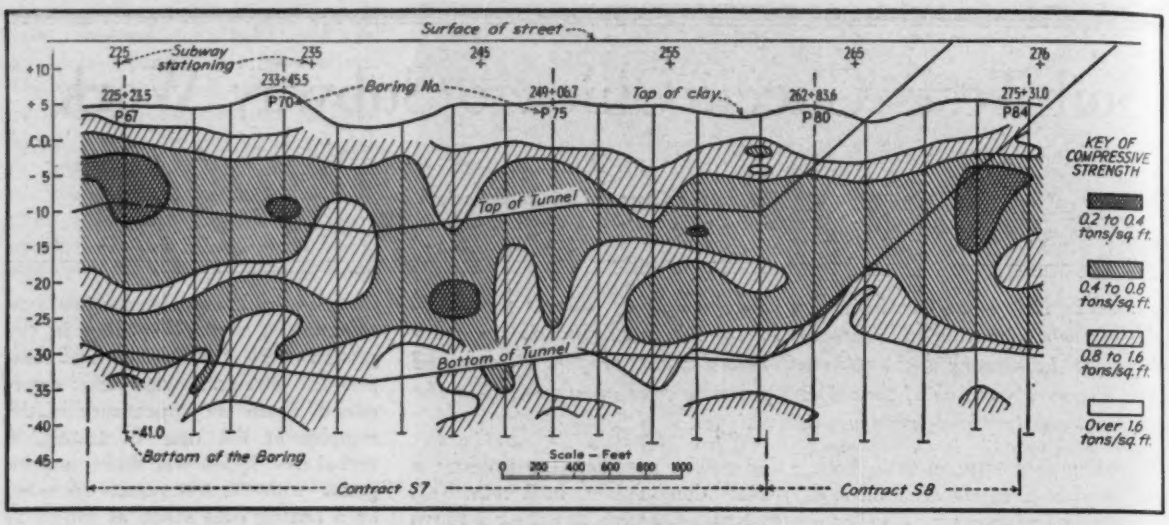


Fig. 2. Soil profiles were platted from the individual boring records for all sections of the subway; example shown is the soil profile along State St., from Goethe to Clay streets.

from each heading. Results of these tests indicate the presence of any local variations in the soil which occur within the 300-ft. bore holes and serve to determine the size of bearing blocks necessary to support the arch ribs of the temporary tunnel lining and to determine whether or not unexpected events are caused by soil variation or some procedure in the method of construction. The tunnel headings also offer opportunity to procure undisturbed samples which, by comparison with the boring cores originally taken, show the amount of disturbance caused by the boring operations and the consequent relation between actual compressive strength of the soil and that observed from the borings.

Settlement observations

A vital part of the soil program is the observation of settlements caused by the excavation. Settlement profiles are established every 20 ft. across the street surfaces above the subway, with six points for settlement observation on each profile. In addition, numerous reference points are located on all buildings within about 80 ft. of the tunnels. Observations are made daily on all points in the proximity of construction activity, and more often if necessary.

To correlate the data obtained, and to translate the quantitative soil data into terms of actual construction experience, occasional measurements are made in the tunnels themselves during mining and construction operations. Particular attention is paid to the movement of the clay during and after mining operations. Inward movement of the working face is measured by driving a spearhead into the clay ahead of the face and determining its position at the time of placing the spearhead and at the time when it is encountered by the miners. Lateral squeeze of the sides is measured between reference points driven into the clay walls through holes in the lining on opposite sides of the tunnel. Settlement of the crown and of the base of the lining is determined by a surveyor's level. During the time of these measurements, which usually cover a 24 to 48-hr. period, a continuous detailed record is kept of all mining operations, setting of braces, grouting, concreting and other construction activities, and on the surface, settlement readings are made at 2- or 4-hr. intervals. Study of these data, together with the soil test data, has added much knowledge of the relationship between construction methods and the behavior and settlement of the soil, and has suggested desirable improvements in construction methods from time to time.

Full-size test sections

In order to obtain information concerning the pressures exerted by the earth on the tunnels, several test sections are to be incorporated in the full-size structures. At each measuring section a 20-ft. length of tunnel will be so constructed as to permit the complete determination of the displacements and strains in the lining, from which the value of the external pressures can be determined. In addition, direct-pressure measurements by means of pressure cells will be made as a check on the results from the strain measurements. The measurements will be continued over a period of years to determine the extent of changes in pressure from the soft clay as time progresses.

Summary and credits

The large amount of data obtained on this project has furnished material for a statistical study of the Chicago clays which will be made available to engineers working in the area. Similarly, through cooperation with D. J. H. Bretz of the Department of Geology, University of Chicago, additional understanding of the glacial history of the region is being gained.

The soil mechanics program has been made possible through the active interest and cooperation of Mayor Edward J. Kelly and of the city council of Chicago, under whose authority the subway is being constructed. The design and construction are carried on by the Department of Subways and Traction, of which Philip Harrington is commissioner, and Ralph H. Burke, chief engineer. Joshua D'Esposito is project engineer for the PWA, and Karl Terzaghi is consulting engineer on matters pertaining to soil mechanics. Most of the soil testing is carried out in the laboratory erected by the city, but certain tests are performed in the soil mechanics laboratory, Armour Institute of Technology.

FIG. I. PIPE LAYING AT THE RATE OF FIVE HUNDRED FT. PER HR. WAS MADE OVER THIS TERRAIN.

Pipe Laying Record at Little Rock

Contents in Brief—Nine days after the order was given to lay a 6-in. water main to a cavalry camp, 1¾ miles from the city, municipal authorities and business interests in Little Rock had the line in place and ready to carry water.

A REMARKABLY FAST underground installation of water line was made recently at Little Rock, Ark., where 9,400 ft. of pipe was placed in trenches, coupled, backfilled and ready to carry water nine days after word was given to start the project. The pipe used was 6-in. asbestos-cement. It was placed in a trench about 2 ft. deep, the pipe being laid roughly parallel to the ground surface. The trench was dug along the shoulder of a narrow dirt road.

This record installation was made to provide water for a section of Camp Joseph T. Robinson (formerly Camp Pike) where a detachment of United States cavalry troops was ordered for tactical training. Business interests in Little Rock paid for the trenching, the pipe and its installation, and Pulaski County officials furnished convict labor for backfilling. The Little Rock municipal water department supervised the work.

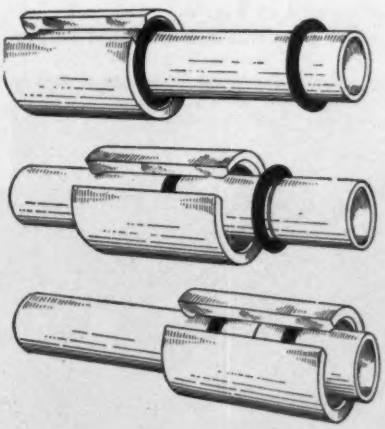


Fig. 2. Sleeve joint with rubber ring gaskets facilitated pipe assembly.

The work proceeded so swiftly that the following chronological order of events seems best adapted to tell the story:

Nov. 6—Word was given late in the evening to start the job as soon as possible. The day before, on Sunday, the route had been selected in anticipation of the work, and levels were run by surveyors from the state highway department. Arrangements were made with the James Construction Co. of Little Rock to dig the trench and install pipe at a contract cost of 20c per foot.

Nov. 7—A trench-digging machine adjusted to make a 24-in. cut moved on the job at midnight. Pipe was ordered from Johns-Manville Corp. to be shipped from Waukegan, Ill.

Nov. 8–10—Trench digging was carried on continuously for 24 hrs.

Nov. 11—Trench digging completed. A cut 24 in. wide and about 30 in. deep was made over a length of 9,400 ft. in a time period of 69 hours. The soil was of a sandy-clay nature overlying shale and sandstone; some blasting was required where rock was near the surface. The first car of a shipment of 2½ cars of pipe arrived in the railroad yard at 2:30 p.m. and unloading began; the haul to the job was 7 miles. Pipe laying began using two crews of three men each, working on opposite

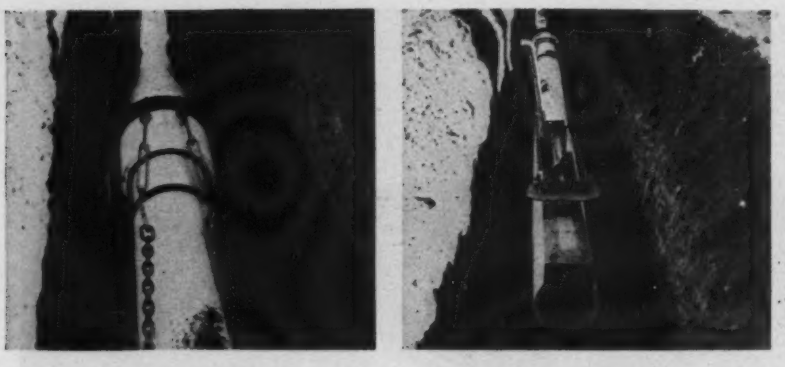


Fig. 3. Harness with hydraulic jack for coupling pipe. At the left is the pulling-collar which forces the sleeve coupling over the gaskets when tension is applied through chains attached to a hydraulic jack (right). The jack is hooked over the end of the pipe.

ends of the line. Two 8-hr. shifts were employed for pipe laying. A heavy rain beginning at 6 p.m. on Saturday halted all work until 8:30 a.m. on Sunday.

Nov. 12—Work was halted at 4 p.m. Sunday when the supply of pipe couplings ran out. Up to this time 2,300 ft. of pipe had been laid in a seven-hour period; the rate of pipe laying was about 328 ft. per hour. Backfilling operations were begun, using about 50 men from the county prison.

Nov. 13—Pipe laying began at 8 in the morning, and 10 hrs. later a total of 5,100 ft. of pipe had been laid; this was at the rate of 510 ft. per hour.

Nov. 14—Pipe laying was completed at 2 p.m. and the main was ready to receive water. The total elapsed time for the installation was slightly less than nine days from the hour the order was given to start work on the project.

Pipe laying method

Pipe was laid in lengths of 13 ft., and joined together with sleeve couplings and solid rubber ring gaskets. With this type of joint the coupling is pulled over the gasket (one at each end of the pipe) and thus compresses the rubber to form a watertight connection (Fig. 2). For making changes in alignment and grade, shorter pieces of pipe (in lengths of 6.5 ft. and 3.25 ft.) were used; deflections at the joint up to 15 deg. can be made without endangering the watertightness of the joints. The joints are made up with the aid of a puller harness hydraulic jack assembly as illustrated in Fig. 3.

The pipe was not sterilized before use because Little Rock water carries a residual chloramine content, and the main was flushed until this residual was carried to the farthest point of the line. The capacity of the main is 160,000 gal. a day. The highest pressure to be carried is 60 lb. per square inch. To maintain full pressure and capacity a small booster pumping station will be installed on the line.

Supervising the work for the Little Rock Municipal Water Works was Marion L. Crist, engineer and director of public relations. F. F. Schneider, field engineer from the St. Louis office of the Johns-Manville Corp., supervised the pipe laying and jointing.

Fig. 4. Trench-digging machine which expedited the work by excavating the 9,400 ft. of trench in 69 hrs. M. L. Crist, engineer, Little Rock Water Works, stands at the left.

• • •

Gas Production From Waste Disposal

An extended study of methane gas production by decomposition of organic matter through anaerobic fermentation, and the possibilities of commercial use of the combustible gas, are discussed in *Bulletin* No. 32, recently issued by Illinois State Water Survey, Urbana, Ill. Following a historical summary there are sections dealing with the fermentation of pure compounds, cellulose and industrial wastes, these last including vegetable, milk, distillery and packing-house wastes. There is also an extensive bibliography.

The cost of the gas will vary with that of the material fermented, and as a general conclusion it was stated that: "Under present economic conditions, fuel gas produced by anaerobic fermentation is too expensive to compete with other kinds of fuel when the raw material must be purchased or transported any distance. As a method of waste disposal, anaerobic digestion is quite economical, because of the gas which is produced as a by-product. Under good conditions the process can be made to pay for itself."

It is explained that this report, dealing particularly with the production of methane, supplements three previous reports which laid stress on the anaerobic phase of treatment of wastes, namely: *Circular No. 8*, chemical studies on sludge digestion; *Bulletin No. 29*, studies on two-stage sludge digestion; and *Bulletin No. 30*, laboratory studies of sludge digestion.

Welded Cable Saddles For Tacoma Narrows Bridge

JONATHAN JONES
Chief Engineer, Fabricating Steel Construction Division
Bethlehem Steel Co., Bethlehem, Pa.

Contents in Brief: *The first welded cable saddles on record have been manufactured for the Tacoma Narrows Bridge. Machining difficulties were avoided by welding the saddles rather than casting them.*

A NEW DEPARTURE in cable saddles for suspension bridges is embodied in the Tacoma Narrows Bridge in Washington where these heavy and rather complicated pieces are made of welded structural plates rather than of the usual steel casting. Designed to accommodate the 17-in.-diameter cables of this 2,800-ft.-span suspension bridge, the cable saddles will be subjected to a vertical reaction of 10,800,000 lb.

One of the major problems in the saddle design was the transfer of this cable load to all principal elements of the tower leg, which is made up of four square steel shafts assembled to form a cross with five cell spaces as shown in Fig. 1. The width transversely of the bridge is 13 ft. and the length has the same dimension.

The decision was to use a cross-shaped saddle, 10 ft. wide over the central third of its length and 4 ft. 2 in. wide fore and aft. The saddle length of 13 ft. 9½ in. conformed to the tower design and gave a satisfactory bearing pressure for the cable wire in the saddle trough. The 10-ft. width, however, left part of the two lateral column cells uncovered, and deep diaphragms were built into the cells at the extremities of the saddles to distribute the load over the remainder of the column material.

The decision to weld these saddles instead of casting them was made without utilizing comparative cost estimates but it was felt that the difficulty of securing sound castings of the shape required, coupled with the cost for patterns and the danger that rejection of a casting might disrupt the schedule for completion of the bridge, gave the welded design an advantage. Another factor that favored welding was the fact that at the time the bridge was fabricated there was no boring mill known to be available that had sufficient height to accommodate the 10-ft. wide pieces in the upended position during machining operations. With a welded design it was possible to machine the trough before it was attached to its base and bracket.

Two views of the saddle fitted up for welding are shown in Fig. 2. Before this assembly was made, the cable trough, a rolled slab 8 in. thick, was curved at a low red heat to the 16-ft. radius under a 7,000-ton hydraulic bending press, and welded to a 2-in. vertical stem piece that runs the length of the underside of the trough slab. The T-section thus

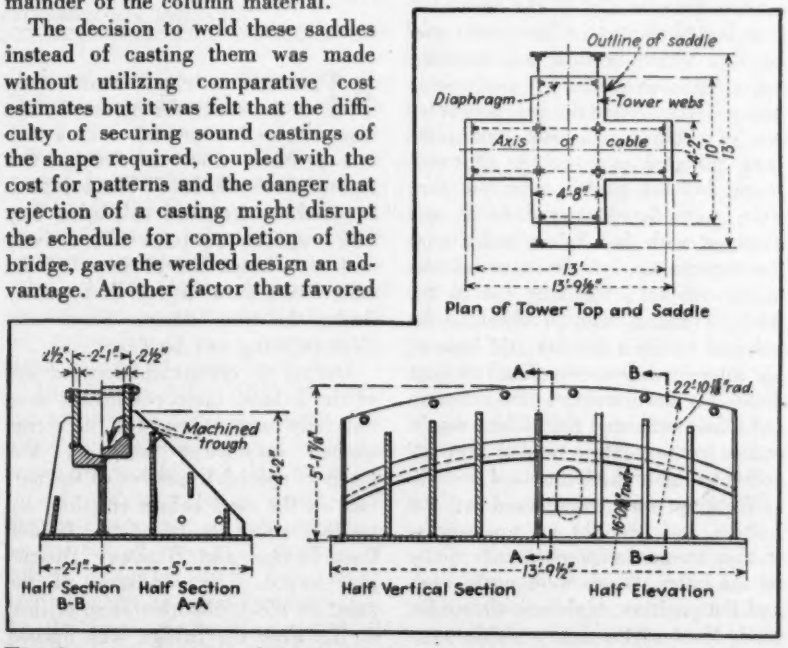


Fig. 1. Built-up welded cable saddles for the Tacoma Narrows Bridge.

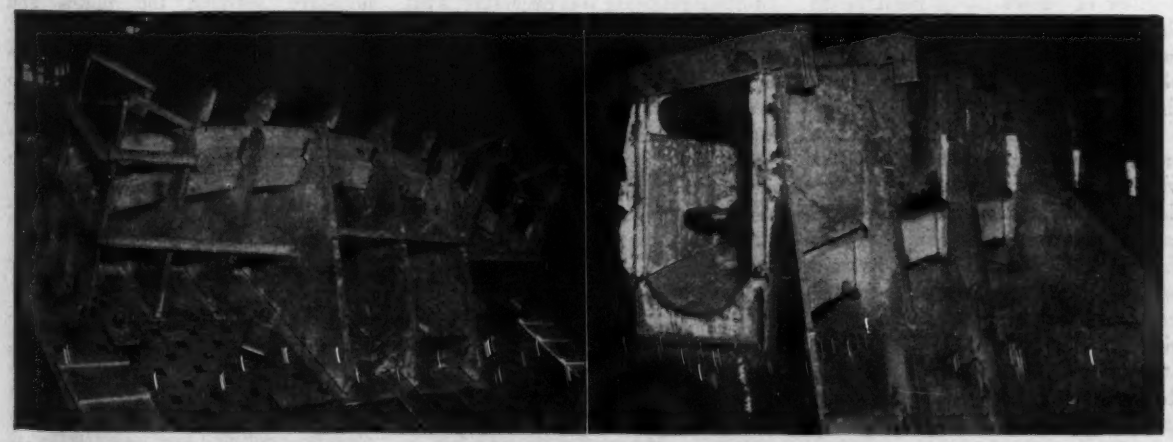


Fig. 2. Two views in the shop showing stages of saddle assembly preparatory to the final welding operation.

formed was rough-machined along the slab sides and in the cable trough, after which it was stress-relieved. This was the only stress relief given to any part of the saddles since stress relieving of the more complete assembly would have required a final machining which could not be accomplished on available equipment. For the nature of service to be performed by the saddles, it is believed that a general stress relief is not important.

After the T-sections had been given their final machining, the bottom edge of the stem piece was welded to the 1½-in. base plate which had been ordered 2 in. thick to allow ½ in. for a final bottom cut. The waste from the base plate was also used for some of the 2-in.-thick bracket plates.

As shown in Fig. 2, the base plate was bolted down to a heavy cast steel surface which in turn was mounted on a trunnion device for positioning the welding. After the pre-assembled tee of cable groove and stem piece was mounted and tacked, all transverse bracket plates, nine on each side, were flame-tailored to fit and fastened with full T-butt welds with reinforcement. In the case of the wider brackets, reaching out to the 10-ft. width, horizontal shear is developed between bracket and base of an intensity requiring this full butt weld; for the narrower bracket computations indicated that fillets would suffice but butts were used to keep all joints to the highest standard.

Welding was commenced at the bottom and brought up toward the trough to minimize shrinkage pulls on the latter. Welds were positioned, and flat position, high-heat electrodes used. Most of the heavy welds were made in step-back sequence, the full number of passes being built up in short lengths with intervening gaps for later closure. The resulting assembly showed no distortion of the machined cable groove.

The next operation was the attachment of the 2½-in. vertical side plates which had been flame-cut to dimension. These plates were heavily braced across and were also supported by the tops of the side brackets. The weld joining these side plates to the trough was a 2½-in. unsymmetrical section which was considered most apt to produce unmanageable warpage. However, the maximum variation across the tops of the side plates proved to be only ⅛ in.

The final assembly operation was to insert between the transverse bracket plates the longitudinal stiffening plates and to connect them with fillet welds. These end-fillets, being of 1-in. leg, exerted considerable pull, and at the top of the wide brackets pulled the plates in slightly, this being the only spot in the entire assemblage where any warpage is observable by the naked eye.

The design of the saddles was worked out by close cooperation between the Washington Toll Bridge Authority, through Clark H. Eldridge, its bridge engineer, and the engineering and manufacturing departments of Bethlehem Steel Co. The finished saddles weigh 15 tons each as shipped. The first two were shipped three months after the general principles of the design and process were established firmly enough to order from the mill the rolled material required for the saddles.

Paint Maintenance Problem On Golden Gate Bridge

MAINTAINING PAINT PROTECTION on the steelwork of the Golden Gate Bridge has proved to be a serious problem since the bridge was opened in April, 1937. The bridge is exposed to frequent salt-laden fog, which attacks the paint film actively and also keeps the surfaces of the steel moist to a degree that greatly limits the time during which efficient painting can be done.

During the design and construction of the bridge, these conditions were not fully understood, and in consequence insufficient attention was given to special treatment of the surface of the steel before erection, according to a report of the Golden Gate Bridge and Highway District just issued. The condition of the paint on the steelwork was so critical at the time the bridge was opened that an acceleration of the original painting program was necessary. Part of the difficulty arose from the six months' delay in the construction of the bridge, in consequence of which the main towers, representing more than 40 per cent of the steel tonnage, had had an exposure of one year at the time the bridge was opened and maintenance painting at a cost of $130,000 had already been necessary.

More active maintenance work began immediately after final completion of the steel contract, in December, 1937. A paint crew started at the bases of the towers, where rust had attacked the rivet heads and plates and thoroughly cleaned the surface and applied hot coal tar paint. Cleaning and painting have progressed since then on both towers and suspended steelwork. During the past year the outside of the San Francisco tower was completely repainted and the interiors of both towers were spotted where most needed, while painting of the stiffening trusses and floor steel covered about 28 per cent of this tonnage.

Loosening of mill scale is principally responsible for the paint failure. Rusting progresses under the loosened mill scale so that soon much of the surface is involved. Then the paint must be removed and the metal surface thoroughly cleaned. The best method of cleaning has been found to be to use pneumatic chipping hammers with specially made studite-tipped tools to remove the rust and scale, and then to pass a dehydrating torch over the metal to dry out the moisture between the plates and around the rivet heads and also to remove the remaining traces of scale and leave a warm, dry surface to receive the priming coat. The surface thus cleaned is wire-brushed and immediately primed while still warm and dry.

Various new paints are being tested in the course of the work, many full sized panels of the bridge being covered with specimen paints so that their resistance under actual exposure on the bridge can be observed. The steel is being primed with a heavy coat of red lead and oil, which has stood up best in service so far except on horizontal surfaces where moisture is present almost continu-

ously; here a coal tar paint that has proved its resistance in past experience is used. For the finish coat, the original International Orange used on surfaces exposed to view is still being applied, but the composition of the coat has been modified to increase the life of the film. On the test panels special paints are used for the cover coat to develop experience on their relative resistance. Surfaces not exposed to view are painted with commercial carbon and graphite paints, which have given good results under exposure tests.

Pollution Legislation: Its Present Status

Contents in Brief—Stream pollution legislation has been actively discussed in the Congress since 1936. Chief difference between opposing measures centers on the establishment of an advisory agency to cooperate with existing state authorities or the creation of a control body with broad powers enforceable by court action. The present status and fundamental differences of present legislation are outlined.

WIDESPREAD INTEREST in the subject of stream pollution and in the measures for control which have been debated in Congress since 1936 calls for a statement on the present status of federal legislative efforts. Addressing itself to this need the committee on stream pollution of the Cincinnati Chamber of Commerce has issued a pamphlet known as Communication No. 44. Signed by Hudson Biery, chairman of the committee which has vigorously sponsored the Barkley bill in Congress, the pamphlet outlines fundamental points of difference between this bill and other proposed legislation. The following is an extract from Mr. Biery's statement.

The Barkley bill (S-685) which sets up a national policy for dealing with stream pollution control, in line with the practices and experience of the U. S. Public Health Service over many years, was passed by the Senate on May 1, 1939. The bill was referred to the rivers and harbors committee of the House, which reported it out favorably on May 10, 1939. By favorable action of the rules committee of the House, it was placed on the calendar where it is ready for consideration by the House when the 76th Congress again convenes.

The Barkley bill was first introduced into Congress in 1936 and year by year has undergone a refining process. Many changes have been made, after careful consideration and support of many different types of organizations and public officials from all parts of the United States. It is now considered to be a strong piece of constructive legislation. Three times the Barkley bill has been passed by the United States Senate —twice by the House, only to be defeated the first time by senatorial courtesy accorded the author of the Izaak Walton bill and vetoed the second time on account of a budgetary defect that is being corrected. It again awaits action in the House.

The Mundt bill (HR-6723) was introduced into the House on June 7, 1939. It is a successor to the Lonergan bill which at no time has been able to muster a broad measure of support, nor has it ever been reported out of committee. The Mundt bill is supported by a well organized minority group of fishermen, led by the Izaak Walton League. They insist upon a drastic bill to create a centralized agency, with power to act through the federal courts and bring suits against any city or industry which may discharge directly or indirectly into a stream any waste, whether in the solid, gaseous or liquid state, if such waste is injurious to human health or any form of life, including aquatic life. In brief, this bill seeks to cure by a drastic prohibitory law the evils of stream pollution, and to take away the power of the state and federal public health agencies to handle these perplexing problems which are now being solved by scientific, cooperative measures as rapidly as funds are available.

The Barkley bill provides for placing stream pollution control, from a national standpoint, under the direction of the same federal agency—the U. S. Public Health Service—where stream pollution investigations have been handled successfully for the past twenty-five years. Limited funds and lack of personnel and the absence of an adequate law have not permitted a broad national program of stream-pollution control to be undertaken by this agency in the past.

The Mundt bill seeks to change the federal agency dealing with stream pollution matters, to transfer control to the U. S. Army Engineers, an agency lacking in experience in dealing with public health matters, having no contacts with or interests in state health departments, and without trained personnel to undertake stream pollution investigations, an agency which by its very nature should not be called upon to police the municipalities or industries of the states.

The Barkley bill is unquestionably constitutional. It does not invade or nullify the police power of the states relating to public health, water supply and sewage disposal as the Mundt Bill proposed to do. It carries forward the same practical program of cooperation with state health departments in matters relating to stream sanitation—only, it allows for an expansion of the work. Under its provisions, it would be possible: (1) to give more technical assistance than formerly, (2) to give some financial assistance in the way of building up a competent state staff to deal effectively with these matters on a joint basis, (3) to encourage cooperative activities in interstate stream pollution problems.

The Mundt bill, especially in Sections 7 and 10, appears to be of doubtful constitutionality. In Section

7(b) the Chief of Engineers is given authority to outline treatment and promulgate regulations as to the discharge of any material into the waters of a district. This appears to eliminate any state control over water supplies and sewage disposal. Section 10, which declares the discharge of wastes to be a public nuisance, is probably unconstitutional since it sets up a federal policy for stream pollution control, although it would seem that this matter, under the Constitution, can be handled only under the police power of the state.

The Barkley bill provides $300,000 a year to enable the U. S. Public Health Service to administer the work; the Mundt bill would require $500,000 a year for the U. S. Army Engineers to carry on the program. The Barkley bill establishes an upper limit of $50,000,000 per year for loans and grants to cities for remedial works. The Mundt bill places no limit on the financial assistance to local communities.

Relations with industry

Each year, over several decades, efforts have been made in Congress to enact a national stream pollution control law. Failure has resulted on account of the drastic nature of the bills proposed. President Roosevelt transmitted to the Congress on Feb. 15, 1939, a report of his special committee which had studied the question carefully for three years. This report showed the tremendous difficulties of devising suitable methods of disposal of certain industrial wastes, pointing out the fact that the different basic industries were making efforts to lessen stream pollution. The committee recommended legislation along the lines of the Barkley bill, providing for state and federal cooperative effort of health services.

Certain changes have been made in the present Mundt bill, since it was first introduced, to try to provide for the many instances where no known methods are available for treating detrimental industrial wastes. A means for the extension of time for complying with the law after hearings have been held has been provided. The bill now provides that the U. S. Army Engineers may grant five-year periods of freedom from prosecution after a hearing has been held and proper evidence submitted by the industry. This may prove to be a dangerous procedure, which is fraught with the possible difficulties associated with the granting of exemptions and waivers of execution.

These changes relate to minor matters and in no way alter the fundamentals of the Mundt bill, which are basically unsound. Such legislation opens the way for another invasion by the federal government of the states, and provides for drastic, centralized control of stream pollution. In our opinion, this bill will not stand the test of constitutionality, and to try out the proposal will interrupt the present successful work and reduce the progress now being made.

Proving-Ring Design Chart

R. W. KLUGE
Talbot Laboratory, University of Illinois, Urbana, Ill.

THE DESIGN of an elastic load ring is quite simple and follows from formulas that are derived in any standard text on advanced mechanics ("Strength of Materials," Part II, by S. Timoshenko), but because of the interdependent variables involved, the task may become laborious. For those who are confronted with the problem of designing such a ring the accompanying curves may prove to be quite useful. They are based on a load of $P = 1{,}000$ lb. and a width $b = 1$ in. and were obtained from the following formulas which are derived for a thin ring.

$$\text{Deflection } \Delta = \frac{0.225\, P\, d_m^3}{E\, b\, t^3}$$

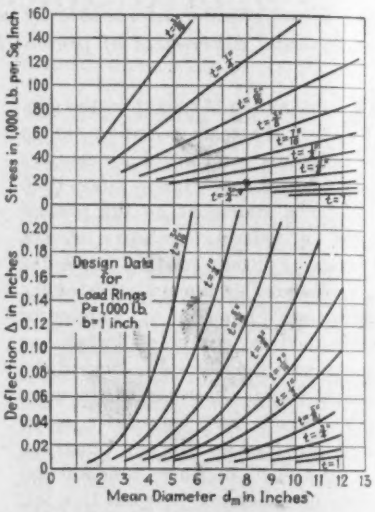
$$\text{Max. fiber Stress } f_s = \frac{0.954\, P\, d_m}{b\, t^2}$$

where

P = load
d_m = mean diameter
t = wall thickness
E = modulus of elasticity
b = width of ring

The above expressions neglect the effect of curvature on stress in the extreme fiber, however for the ratios of wall thickness to mean radius covered in these curves the correction factor which should be applied to the values given by the above formulas is small and probably no larger than uncertainties resulting from details of design. In the extreme cases, namely for a ratio of $d_m/2t = 10$, the stress in the inside fiber may be 7 per cent greater and in the outside fiber 6 per cent less than the values given in the curves. ("Correction Factors for Use in Straight Beam Formula, Advanced Mechanics of Materials," by F. B. Seely).

The curves cover variations in ring wall thickness from $\frac{3}{16}$ in. to 1 in. and are applicable to any given load and to any width of ring, since both deflection and stress are proportional to load and width. Thus, for a load other than 1,000 lb., it is only necessary to multiply the values of deflection and stress by the proper factor. Likewise for widths other than 1 in., it is necessary to divide these values by the given width.



Proving-ring design charts based on 1,000 lb. load and 1 in. width.

The above formulas were used for the design of the 1,000-lb. and 100,000-lb.-capacity rings. A dial gage graduated to 1/10,000 in. was used for measuring deformation, each division of the gage representing 10 lb. on the 1,000-lb. ring and 180 lb. on the 100,000-lb. ring. Calibration data indicated a reliable accuracy of these instruments of ± 1 per cent at as low as one-fifth of their capacity.

FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

Portable Rack for Oils

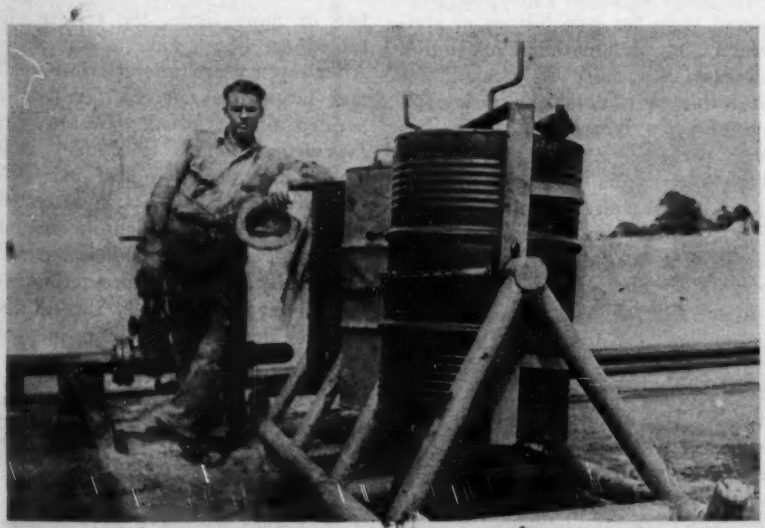
ELTON STERRETT
Longview, Tex.

Wastage of oils and fuels from original drums can easily mount to considerable totals unless provision is made for handling the drums and permitting easy control of their contents.

A sturdy skid frame, welded from sections of 4 and 3-in. pipe, provides one contractor with a mobile support for oils and fuels, the drums being swung in frames pivoted so that the drum will always tend to return to the vertical when released. These frames extend across the tops of the drums, and are equipped with hold-down screws and crank handles so the drum can be secured in place, preventing slippage and accidental injury while drawing fluid. A chain extends across the open side of the frame, restraining each drum in case the frame is tipped the wrong way.

By using snap spouts on these drums, close control of the contents is assured, the usual procedure being to hold the drum in pouring position by the handle and permit the edge of the bucket or can to hold the spout cover open. As soon as released, rotation of the drum toward the vertical also releases the vent cover, and the drum is again sealed.

A color code: red for gasoline, blue for lubricating oil and white for kerosene aids in proper selection from the drum rack.



Portable oil and fuel rack permits one-man handling of drums and allows small amounts to be drawn without waste.

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Scaffold for Divers

To examine the underwater face of an old stone-filled crib breakwater in Chicago the diver worked from a submerged scaffold suspended from, and moved along the work by, a traveler shown by the accompanying illustration. The equipment made on the job consists of a traveling 10x12-ft. platform, with cantilever outriggers supporting a weighted swinging scaffold of 2x12-in. planks by ¼-in. wire cables operated from a hand winch on the back of the rig. A depth pole set at one end of the scaffold enabled the recorder to keep track of the various depths from which the diver was reporting. A 5-lb. plumb bob permitted the diver to reference his measurements which were taken with a specially devised 30-in. rule made of ¼x¾-in. brass rod with studs 3 in. apart. The measuring stick was secured to the diver's outfit by a lanyard. In addition to the back-geared hand winch to raise and lower the swinging scaffold, an operation controlled by cord to a whistle, an air compressor of 14-cfm capacity powered by a 4-hp gas motor was mounted on the back portion of the traveling rig. The inspection was made by a diver who reported his findings and measurements over a two-way telephone to an attendant who in turn repeated the observations to a recorder who had previously made up blank sheets for the data.

Traveling rig on Chicago crib carried swinging scaffold from which diver makes underwater condition survey

M. C. Levinson, structural designer, Sanitary District of Chicago, was in charge of collecting the data as to condition of the crib, and Frank Hefling was the diver.

CAMERA MEMORANDA

The John W. Cowper Co., of Buffalo, N. Y., has reduced the length of live-boom cable on long-boom cranes by half with the addition of two hog-rods between boom tip and the cable sheaves, as shown in the accompanying illustration. As the boom line is a six-part cable, considerable saving is effected by this reduction in length of running line.

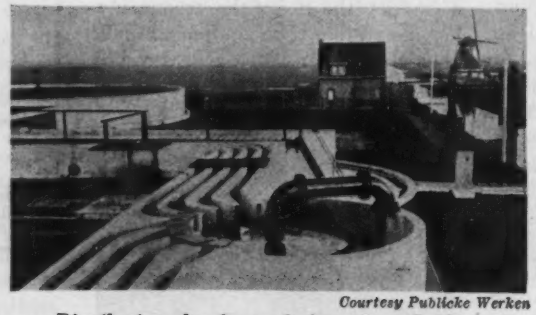
Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

TEMPERATURE AND FILTERS—All biological life responsible for purification of sewage is affected by temperature. Within limits, purification and nitrification increase with higher temperatures. Practical operation and various experiments dealing with the interdependent biological communities responsible for the decomposition stabilization and purification of wastes have indicated that the optimum temperatures are between 85 and 95 deg. F. Carefully controlled small-scale experiments with model filters conducted by Wilson and Hamlin (*The Surveyor*, July 14, 1939) tend to show that the optimum temperature for trickling filter operation is about 95 deg. F. At higher temperatures (100 deg. F.) nitrification was reduced similarly to that at lower temperatures (70 deg. F.)

At 110 deg. F. only traces of nitrites with high nitrates were found, but the B.O.D. showed serious deterioration. At 120 deg. F. oxidation practically ceased with high B.O.D. values obtained from the effluent. The nitrifying power is not destroyed by temporarily raising the temperature, because it commenced almost immediately when the temperature was reduced to 90 deg. F. It is doubtful that artificial heating of trickling filters is economical, unless hot trade wastes are present. The remarkable performance of the Decatur, Ill., trickling filters reported some years ago, where large volumes of hot corn wastes were received, is of particular interest in this connection.

SEWAGE DISTRIBUTION—Proper distribution of sewage into a series of settling tanks remains a problem at many treatment works, especially if the flow is relatively low and many settling units must be served. During the last few years Kessener in Holland has been working on this problem and now he has designed a series of distribution chambers and channels which are said to produce excellent results. Boogerd (*Publicke Werken*, Amsterdam, April, 1934) in describing the new sewage treatment works at Leiden, shows a distribution chamber and channels leading to eight sedimentation units taking care of a flow of 1.6 mgd (see cut).



Courtesy Publicke Werken

Distribution chamber and channels at Leiden.

POLLUTION PREVENTION—Methods to prevent pollution entering a water supply reservoir vary from place to place. In densely populated areas the possibilities of accidental or unintentional pollution increase, especially if communities lie within the watershed. For a number of years Jersey City, N. J., has been perfecting safety measures to prevent pollution from entering the Boonton reservoir. Recently W. Mallelieu, sanitary engineer of the water department, constructed a system of perforated rubber piping to distribute chlorine in a brook passing through a recreational area; a similar device is installed in the Rockaway River, the chief source of supply. The chlorination equipment is located 7 to 8 miles above the inlet to the reservoir and just below the possible sources of pollution.

PEAT FILTERS—Various types of media for trickling filters are in use in different parts of the world. Usually the materials available (stone, slag, gravel, broken pottery, clinker) are selected from the standpoint of cost and durability. Other materials (wood, cork, ceramic rings, broken bricks, tin cans, etc.) have been used to advantage. With a view toward eventually utilizing the entire filter as a source of fertilizer, a trickling filter has been built in Zurich, Switzerland, from peat blocks. The filter is dosed with a fairly strong sewage at a rate of 1,725 gal. per cubic yard of peat.

The upper layer of the filter must be replaced about every two weeks. To the discarded peat blocks fresh sewage solids are added, and then the blocks are covered with lime and allowed to rot. In two or three months the process is completed when air is allowed to enter the mass. The residue is a fertilizer very similar to rotted stable manure. This Ca-To system was described by Büttner (*Gesundheits Ingenieur*, Aug. 19, 1939).

AERATED FILTERS—Artificial aeration of trickling filters may be of considerable importance when loading is high on account of large volumes of weak sewage or when the sewage is exceptionally strong. With the present interest in high rate trickling filters, treating more sewage with a resultant lower degree of purification, and recirculation treatment of the same sewage two or more times, the results obtained at Soest have significance. After seven years' operation of small and large-scale covered, artificially aerated filters, Blunk (*Gesundheits Ingenieur*, June 17, 1939) concludes that the biological mass on filter stone, the same as in activated sludge, is able to do a definite amount of work. The work done is influenced principally by temperature and quantity of oxygen available. Typical results for dry weather sewage in ppm are:

	Settled Sewage	Filter Effluent	Activated Sludge Eff.
Total nitrogen	30	19	18
Ammonia	19	7	6
Nitrates and nitrites	1	10	10
Dissolved oxygen	0.7	6.0	2.6
B.O.D.	222	14	7
Oxygen consumed	343	80	74

Designed to treat 660,000 gallons, the plant handles 1,160,000 gallons.

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CASE TRACTORS are great performers—have been for 47 years. So when New "RPM" DELO comes through extensive factory tests with the verdict—

"Satisfactory for Case Tractors operating on any fuel from gasoline to tractor fuel or distillate"—

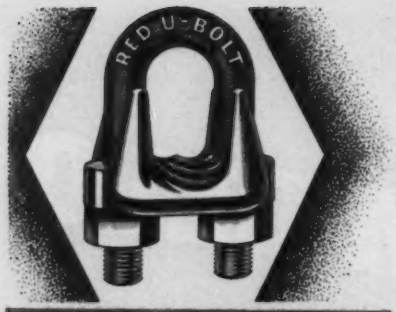
This means it delivers cost-cutting, life-lengthening, profit-raising lubrication! Results of J. I. Case Company tests show: Combustion chambers free of carbon deposits—meaning cooler, smoother, sweeter-running engines! All rings free in the piston grooves. Blow-by and engine wear minimized—full-power performance assured. *Unfailing protection! Longer engine life!*

Profit by New "RPM" DELO in *your* equipment—in stationary, automotive, or marine service. It ends ring sticking. It's safe for *all* types of bearings.

RPM DIESEL ENGINE LUBRICATING OIL

New "RPM" Diesel Engine Lubricating Oil now available everywhere in the gray barrel with the blue head

STANDARD OIL COMPANY OF CALIFORNIA



The Genuine
CROSBY CLIP

Has been the standard of safety for wire rope fastenings since 1883—It is designed for greatest grip and drop forged from special analysis steel. Hot galvanized. Easy to put on; readily inspected. Cheapest because safest.

There is a dealer near you with all sizes in stock. Ask us for his name and address.

AMERICAN HOIST & DERRICK CO.
CHICAGO SAINT PAUL, MINN. NEW YORK
AMERICAN TERRY DERRICK CO.
SOUTH KEARNY, N. J.

Dig and Haul
. . . AT LOWEST COST

Sauerman Tower Excavator digs basin 1250 ft. long and 360 ft. wide for sewage tanks.

YOU can dig and haul at an average speed of 300 to 400 ft. per minute with a Sauerman Machine. This cuts the cost of any excavating or stock-piling work where materials have to be moved distances of several hundred feet. We'll be glad to give you some cost figures or send you our catalog.

SAUERMAN BROS., INC.
432 S. Clinton St. CHICAGO, ILLINOIS

(*News Continued from page 59*)

MEN AND JOBS

WILLIAM B. ARNOLD, San Antonio, Tex., Nov. 6, was elected vice-chairman of the board of directors of the Lower Colorado River Authority. Arnold, who has been a member of the board for the past two years, succeeds T. H. DAVIS, Austin. Davis recently resigned.

J. C. RICHMOND, who received a master of science degree from North Carolina State College last June, has been appointed junior engineer with the U. S. Bureau of Standards, Washington, D. C. Richmond is also a graduate of Alfred University, Alfred, N. Y.

HAROLD E. SUYDAM, Steelton, Pa., is now working as project engineer of the Pennsylvania department of highways and GEORGE T. STEIDEL, Pottsville, Pa., has been appointed bridge engineer.

J. C. BAKER, district engineer at Hope for the Arkansas State Highway Department, has been named assistant chief engineer to succeed A. E. HEAGLER. M. C. METHVIN, district engineer at Camden, will take over Bakers' job and WEBSTER F. TURNER, assistant construction engineer, will succeed Methvin at Camden. Heagler resigned to accept work with the St. Francis Levee Board.

JOHN R. SLADE continues to serve as assistant engineer for the Alabama State Highway Department. The legal proceedings in the Alabama circuit courts seeking to compel Slade to show with what authority he had held the position of chairman of the Overseas and Toll Bridge District while acting as assistant engineer have been dismissed.

MALCOLM N. YANCEY, division engineer of Chipley, Florida State Road Department, has been appointed city manager of Tallahassee. He will begin his new duties Jan. 1 and succeeds H. P. FORD.

MAJOR GEORGE W. GILLETTE in charge of the Wilmington, N. C. district of U. S. Engineers, has been promoted to the rank of lieutenant-colonel. Colonel Gillette, who served in the World War, was appointed a captain of the engineering corps in July 1920. He was promoted to the rank of major in June 1931.

CLARENCE W. DUNHAM, formerly assistant engineer, design division, Port of New York Authority, has been appointed chief structural designer for the Phelps Dodge Corp., New York, to take charge of the structural design work for the new copper smelting plant of the company at Morenci, Ariz.

J. V. LEWIS, engineer and superintendent of parks at Kansas City, Mo., has been appointed city manager temporarily or until a permanent manager can be chosen. Lewis has been superintendent of parks since February of this year and previous to that served nine years as an engineer with the park board.

THOMAS ALLEN JONES, Public Roads Administration, Washington, D.C., has been appointed engineer in charge of highway construction in Nicaragua. Recently the Nicaraguan government was loaned $2,000,000 by a United States bank and Jones will supervise the expenditure of this fund.

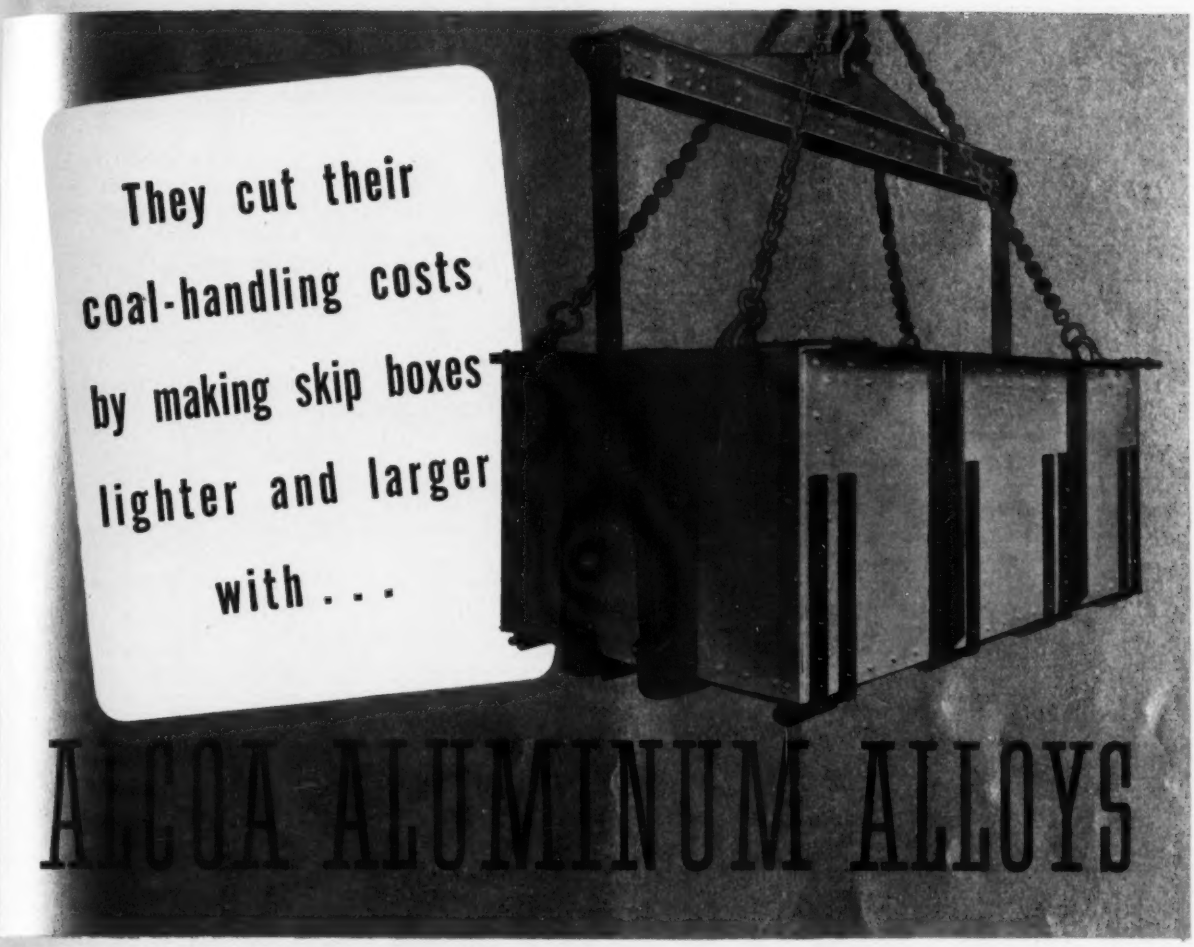
BLAKE R. VAN LEER, dean of the school of engineering at North Carolina State College, has been named chairman of a standing committee of the National Association of Land-Grant Colleges and Universities. The committee will study instruction in engineering in the various schools. Other members of the committee are: R. L. WALES, dean of engineering, University of Rhode Island; L. J. LASSALLE, dean of engineering, Louisiana State University; R. P. DAVIS, dean of engineering, University of West Virginia; H. P. HAMMOND, dean of engineering, Pennsylvania State College, and HARRY CURTIS, engineering dean, University of Missouri.

D. MCGREGOR WILLIAMS, assistant superintendent of the Durham, N.C. city water department, has been appointed superintendent to succeed JOHN C. MICHIE, who died Oct. 16. Williams, an engineering graduate of the University of North Carolina, was employed in 1923 at Durham to assist in the construction of a dam and reservoir on Flat River. At that time he was employed by William M. Piatt, Durham consulting engineer, and in 1930 became associated with the city of Durham. HUGO F. WALKER, office manager of the department, and HARRY P. REDDING, chief operator, have been appointed assistant superintendents.

HARRY F. HOHLT has been appointed commissioner of Marion County, Ind. to fill the vacancy created by the recent death of DOW W. VORHIES.

H. S. PERRY, maintenance engineer of the Ohio State Highway Department,

(*Continued on p. 110*)



YOU MAY BE ABLE TO MAKE SIMILAR SAVINGS

A 1,500-pound reduction in dead weight was effected by constructing this skip box of Alcoa Aluminum plate. That made possible an increase in its capacity from six to seven cubic yards, without increasing the total weight when fully loaded with coal. A bonus load of one cubic yard!

Many other operators of material-handling equipment are similarly utilizing the lighter weight of Aluminum to increase capacities, speed up operations, and reduce power requirements. Because Aluminum is highly resistant to corrosion, maintenance costs are usually less.

Alcoa Aluminum Alloys are available in all forms; sheet, plate, castings, structural shapes. Aluminum can be worked by every metal-working process, so its fabrication introduces no unusual problems. Let Alcoa engineers show you how Aluminum can be applied to your equipment. ALUMINUM COMPANY OF AMERICA, 2108 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA ALUMINUM

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

DIKES AND PILOT CANAL, MISSOURI

OWNER: U. S. Engineer Office, 601 Davidson Bldg., Kansas City, Mo.

PROJECT: Constructing 4,200 ft. of dikes, 3,430 ft. of revetment and a pilot canal approximately a mile long, 200 ft. wide, and 15 ft. deep, along the Missouri River between Kansas City Reach and Sissons Bend; center of work about 6½ miles downstream from Kansas City, Mo.

CONDITIONS: Dikes and revetment to be completed in 100 days; pilot canal in 120 days. Rail, water and highway transportation facilities available. Contractor to furnish all materials. Wage rates specified are: skilled, $1.10 per hr.; semi-skilled, 75c. per hr.; and common labor, 45c. per hr.

BIDS: Seven bids received on dike and revetment construction Oct. 4, 1939, ranging from contract low of $137,943 to $167,875. Eight bids received on pilot canal on the same day range from the low of $72,420 to $149,100.

DIKE AND REVETMENT

LOW BIDDERS:

1. James Constr. Co., St. Paul, Minn. (contract) $137,943
2. Massman Constr. Co., Kansas City, Mo.... 143,624
3. W. P. McGeorge, Pine Bluff, Ark..... 153,617

Pile Dike

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Lumber mattress	3,450 sq.	$6.50	$6.50	$6.80
2. Stone, on mattr. and dike	4,180 ton	2.25	2.30	2.50
3. Stone, in cast paving	720 ton	2.40	2.65	3.00
4. Stone, hand placed paving	330 ton	3.60	4.00	4.00
5. Cr. stone or quarry chips	30 ton	2.00	4.00	3.00
6. Stringers or brace piles	76,600 l. f.	.445	.455	.47
7. Grading	1,200 c. y.	.20	.20	.25

Revetment

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Willow mattress	460 sq.	$8.00	$7.20	$7.50
2. Lumber mattress	2,769 sq.	6.60	6.50	6.80
3. Stone on mattress	4,877 ton	2.25	2.30	2.50
4. Stone in cast paving	1,420 ton	2.50	2.65	3.00
5. Stone, hand placed paving	1,170 ton	3.50	4.00	4.00
6. Cr. stone or quarry chips	275 ton	2.50	2.65	3.00
7. Anchor piles	1,860 l. f.	.45	.455	.50
8. Piles and stringers	37,800 l. f.	.44	.455	.46
9. Grading	96,000 c. f.	1.05	.14	.18

PILOT CANAL

LOW BIDDERS:

1. Martin-Day Co., Lincoln, Nebr. (contract).. $72,420
2. J. A. Terteling & Sons, Boise, Idaho..... 78,597
3. Mark C. Walker & Sons Co., Omaha, Nebr. 87,756

Item	Quan.	Unit Prices (1)	(2)	(3)
Excavation	1,065,000 c. y.	$0.068	$0.0738	$0.0824

SEWER SYSTEM, CALIFORNIA

OWNER: City of Oakland, Calif.; W. N. Frickstad, city engineer, City Hall, Oakland.

PROJECT: Constructing sanitary sewer system in portions of Mountain Boulevard and other streets in Montclair District, Oakland, Calif. Involves furnishing and laying vitrified clay pipe sewer with concrete jacket and in concrete cradle.

CONDITIONS: All materials are to be furnished by contractor. Highway transportation facilities available. Wage rates are: skilled, $1.00 to $1.75 per hr.; semi-skilled, 87½c. to $1.00; and common labor, 81¼c. per hr.

BIDS: Seven bids were received September 5, 1939, ranging from the contract low of $134,455 to $194,194.

LOW BIDDERS:

1. Union Paving Co., San Francisco, Calif. (contract) $134,455
2. M. J. Lynch, San Francisco, Calif..... 148,285
3. W. J. Tobin, Oakland, Calif..... 154,288

Item	Quan.	Unit Prices (1)	(2)	(3)
1. 24-in. vitr. sewer pipe	542 l. f.	$8.50	$9.50	$7.11
2. Same, with conc. cradle	220 l. f.	11.00	11.50	12.04
3. Same, with conc. jacket	20 l. f.	12.00	12.50	8.34
4. 21-in. vitr. sewer pipe	555 l. f.	6.00	7.75	7.81
5. Same, with concrete cradle	283 l. f.	8.00	9.90	8.56
6. 18-in. vitr. sewer pipe	2,358 l. f.	5.00	6.00	5.66
7. Same, with conc. cradle	1,664 l. f.	6.50	7.50	7.31
8. 15-in. vitr. sewer pipe	1,743 l. f.	4.00	4.50	4.51
9. Same, with conc. cradle	100 l. f.	5.00	5.60	5.61
10. 12-in. vitr. clay sew. pipe	850 l. f.	3.50	3.00	3.53
11. Same, with conc. cradle	736 l. f.	4.00	5.00	5.53
12. 8-in. vitr. sewer pipe	29,536 l. f.	1.95	2.20	2.43
13. Same, with conc. jacket	20 l. f.	3.00	3.00	3.00
14. Same, with conc. cradle	624 l. f.	2.50	2.60	5.00
15. 8-in cast iron pipe	144 l. f.	6.00	15.00	10.00
16. 8-in. corr. met. pipe, asbestos mounted	499 l. f.	3.00	3.00	3.00
17. Standard manholes, brick	181 ea.	110.00	100.00	110.00
18. Lampholes	57 ea.	35.00	26.00	25.00
19. Drop connections	20 ea.	10.00	20.00	12.00
20. 5-in. wye branches	356 ea.	5.00	5.00	1.50

BRIDGE APPROACH, RHODE ISLAND

OWNER: Jamestown Bridge Commission, C. H. Brooks, manager. Parsons, Klapp, Brinkerhoff & Douglas, engineers.

PROJECT: Constructing west approach road and toll house, Jamestown Bridge, North Kingston, R. I. Length 3,200 ft.; width, 30 ft.

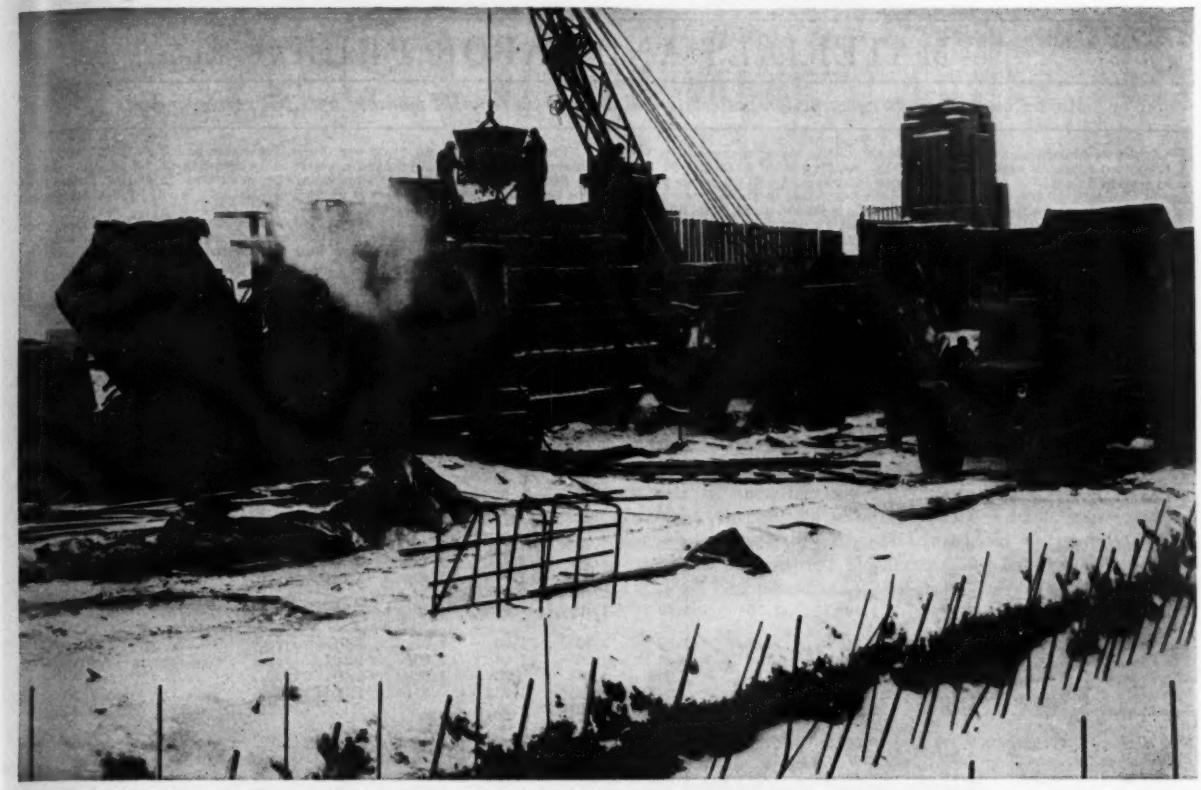
CONDITIONS: To be completed in 240 calendar days. Rail, highway and water transportation facilities available. Contractor to furnish all materials. Wage rates on project are: skilled, $1.00 to $1.67½ per hr.; semi-skilled, 85c. to $1.00 per hr.; and common labor, 60 to 85c. per hr.

BIDS: Eight bids were opened September 15, 1939, ranging from the contract low of $59,585 to $69,936.

LOW BIDDERS:

1. P. Romano & Son, Warren, R. I. (contract).. $59,585
2. J. J. Callahan Co., W. Roxbury, Mass..... 61,079
3. Frank Palazzi & Sons, Johnston, R. I..... 63,066

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clear and grub	L. S.	$675.00	$3,000.00	$4,500.00
2. Earth excav., roadway	13,500 c. y.	.48	.50	.95
3. Rock or ledge excav., rdwy.	20,000 c. y.	1.65	1.50	.95
4. Borrow excav., roadway	3,000 c. y.	.40	.50	.65
5. Trim shoulders, side slopes, fine grading	22,400 s. y.	.025	.04	.05
6. Grouted cobble gutter	980 s. y.	1.30	1.00	2.50
7. Cr. stone base, bitum. mac. pav.	1,311 ton	2.10	2.60	1.80
8. Filler, cr. stone base crse	290 c. y.	1.00	1.75	1.25
9. Cr. stone surf., bit. mac. pav.	656 ton	3.00	2.60	2.75
10. Bituminous binder	15,700 gal.	.00	.12	.09
11. Reinf. conc., pave., curb, sidewk.	49 c. y.	18.00	15.00	30.00
12. 24-in. corr. met. culvert	167 l. f.	3.65	2.50	2.75
13. Guard rail	1,820 l. f.	.85	.50	1.10
14. Toll house and equip	L. S.	4,300.00	4,350.00	6,000.00
15. Water supply pipeline and equip.	1,500 l. f.	1.00	1.25	.50
16. Brick lined well and equip.	20 l. f.	30.00	28.00	50.00
17. Two-car garage	L. S.	700.00	1,100.00	3,000.00



Chicago Cuts Winter Costs

'INCOR' USED FOR LARAMIE AVE. VIADUCT APPROACH

TAKEN in a driving snowstorm, picture (above) suggests cold-weather conditions under which the south approach of the new Laramie Avenue Viaduct was concreted last Winter. City of Chicago specified high early strength cement. Thomas McQueen Company, of Forest Park, Ill., Contractor, used 'Incor' 24-Hour Cement. Result: Service strength in one-fifth the usual time—with a corresponding saving in heat-protection costs.

It pays to remember that the quicker concrete hardens the less time and expense are required to provide costly heat-protection. 'Incor' 24-Hour Cement saves real money on cold-weather work because it gains strength faster and the concrete is safe from freezing sooner. Heat mixing water and aggregates; to avoid heat loss, protect the concrete promptly after placing; then, with 'Incor', provide heat-protection for 24 hours after concrete is placed. When temperatures are below 20°, provide protection for 48 to 72 hours. 'Incor'* saves, at very least, two days' heat-curing on each pour.

To fuel and labor savings, add reduced form costs and lower job overhead as well. Figure these savings on work now in progress; you'll be money ahead if you do. Write for copy of "Cold-Weather Concreting." Lone Star Cement Corporation, Room 2278, 342 Madison Avenue, New York.

*Reg. U. S. Pat. Off.

Sales Offices: ALBANY, BIRMINGHAM, BOSTON, CHICAGO, DALLAS, HOUSTON, INDIANAPOLIS, JACKSON, MISS.; KANSAS CITY, NEW ORLEANS, NEW YORK, NORFOLK, PHILADELPHIA, ST. LOUIS, WASHINGTON, D. C.

LONE STAR CEMENT CORPORATION

MAKERS OF LONE STAR CEMENT • • • 'INCOR' 24-HOUR CEMENT

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

DECEMBER construction material prices show only minor changes from those reported a month ago. Short Leaf Yellow Pine is off $1.00 per M ft. on most sizes in Atlanta; off $1.00 to $2.00 in St. Louis; but up $1.00 on the 2 x 6-in. size in Chicago; up 50c. on 2 x 6-in. and 2 x 8-in. sizes in Dallas; and up 50c. to $1.00 on all sizes in Baltimore. Douglas Fir is up 50c. to $1.00 in Baltimore; but $1.00 lower in Seattle; and $1.00 lower on the 2 x 6-in. in Chicago.

Seattle base price on Douglas Fir plywood is up $3.00 on the 5/8 in. size and $3.30 on the 3/4-in. size. Many manufacturers are still out of the market, however, and will not take orders.

Paving asphalt is up $1.00 per ton in Baltimore and New York, and $1.25 higher in Dallas. Ready-mixed concrete is up 25c. per cu. yd. in Minneapolis.

Structural steel shapes have increased 60c. per 100 lb. in Dallas; Dallas price on new billet reinforcing bars is up 25c. per 100 lb. Welded fabric reinforcing is up on all sizes in all 20 cities.

Labor rates, both common and skilled, are unchanged from November levels. Cement, sand and gravel, crushed stone, brick, structural clay building tile, lime, cast iron pipe, verified sewer pipe and concrete sewer pipe also remains at their levels of a month ago.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT — Per bbl., carload lots, including 40c per bbl. for bags, cash discount not included			SAND AND GRAVEL — Per ton, carload lots			CRUSHED STONE — Per ton, carload lots		CRUSHED SLAG — Per ton, carload lots, f.o.b. plant		CONCRETE Ready Mixed 1:2:4, 50 c.y. or more, delivered
	Cloth Bags	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.90	$2.65	$2.60	$1.75	$1.85	$1.95	$1.65	$1.75	$1.55	$1.65	$7.90
Baltimore	2.31	2.06	1.86	1.75‡	1.75‡	1.25‡	1.75‡	1.75‡	1.75‡	1.75‡	6.50
Birmingham	2.50	2.25	2.05	1.80	1.80	1.45	1.00	1.00	.90	1.15	5.45
Boston	2.75b	2.50b	2.30	1.10‡	1.10‡	.80‡	1.10‡	1.10‡	....	....	6.75m
Chicago	2.75	2.50	2.35	2.15‡d	2.15‡d	2.15‡d	2.15‡d	2.15‡d	1.25‡	1.25‡	....
Cincinnati	2.58	2.33	2.08	1.20	1.20	1.10	1.80	1.80	....	....	6.60
Cleveland	2.29	2.04	....	1.45i	1.45i	1.45i	1.60i	1.60i	1.70i	1.70i	6.85i
Dallas	2.30	2.05	1.85	2.00p	2.00p	1.50p	1.60p	1.84p	....	....	6.20
Denver	3.02	2.77	....	1.20	1.40	.90	....	....	....	....	7.25
Detroit	2.15	1.90	1.70	1.30	1.40	.81	1.45	1.45	1.14‡	1.14‡	6.50
Kansas City	2.56	2.31	2.16	1.85	2.30	1.00	1.91	1.91	....	....	7.90n
Los Angeles	2.82b	2.62b	....	1.00	1.00	1.00	1.00f	1.00f	....	....	5.85
Minneapolis	3.00	2.75	....	1.00h	1.00h	.25h	1.00h	1.00h	....	....	7.60j
Montreal	....	....	1.48	....	....	1.25‡	.85‡c	1.00‡c	....	....	7.60l
New Orleans	2.41	2.16	1.96	1.50	1.50	1.25	....	....	....	....	7.25
New York	2.60‡	2.35‡	....	1.40de	1.40de	.90de	1.65de	1.75de	....	....	7.25
Philadelphia	2.32	2.07	1.87	1.55‡	1.65‡	1.25‡	....	....	1.00	1.00	7.95k
Pittsburgh	2.44	2.19	1.99	1.80‡	1.80‡	2.10‡	2.25‡	2.25‡	1.50	1.50	8.75
St. Louis	2.55	2.30	....	1.50‡	1.50‡	1.25/1.50‡	.85h	.85h	.75g	.75g	7.50
San Francisco	2.72	2.52	2.20	1.36	1.36	1.36	1.46	1.46	....	....	7.63
Seattle	2.95o	2.70o	....	1.00o	1.00o	1.00o	2.00o	2.00o	....	....	7.50o

‡ Delivered. a 10c. allowed for each returnable bag. b 10c. per bbl. off for cash. c Plus municipal tax. d Per cu. yd. e Barge lots alongside docks f Crushed granite. g F.o.b. Granite City, Ill. h F.o.b. plant. i Within three miles of Public Square. j 5% discount for cash. k Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. l Up to 200 cu. yd. m 50c. off for cash. n 25 c.y. or more. o 2% off for cash. p 10c. per ton off, cash 15 days

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice, in Montreal 5% if payment before 15th.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Richard City, Tenn	$1.80	$1.75
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind	1.70	1.65	Steelton, Minn	1.80	1.75
Hannibal, Mo	1.70	1.65	Norfolk, Va	1.65	1.60	Universal, Pa	1.65	1.60
Hudson, N. Y	1.75	1.70	Northampton, Pa	1.55	1.50	Waco, Tex. (Plus 5c. Tax in Texas)	1.75	1.70
Independence, Kans	1.70	1.65	North Birmingham, Ala	1.70	1.65			

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS — Granite per M. lots of 50,000 4x4x8 in.	Brick per M. 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	PAVING ASPHALT — Per ton, less than 80 penetration Tank car	Drums	ASPHALT BINDERS — FLUXES — Per gal. 80-300 penetration Tank car	Drums	CUTBACK ASPHALT — Per ton Tank car	Drums	ROAD OILS — Per gal. Tank car	ASPHALT EMULSION (Quick-breaking) Per gal. Tank car	Drums
Atlanta	$75.00	$39.35	$2.25	$16.60e	$21.80e	$0.0645e	$0.0945e	$0.0684he	$0.0984h	$0.0584e	$0.0644	$0.0684
Baltimore	145.00‡	44.00‡	2.50	13.00	18.00	.05	.08	.055h	.095h	.....	.....	.....
Birmingham	.....	28.50f‡	.....	18.20	23.20	.0747	.1047	.0834h	.1484h	.....	.....	.....
Boston	80.00	47.00	3.25	13.00	18.00	.05	.08	.055h	.125h	.....	.09‡	.12‡
Chicago	150.00	52.00	1.80d	14.00	18.00	13.00g	17.00g	.0525h	.10h	.0275	.08	.12
Cincinnati	112.00	37.50	.....	14.31	18.31	.10	.....	18.00	.....	.0525	.....	.08
Cleveland	110.00	37.25	2.80	15.25	20.50	.07	.08	.07h	.085h	.035	.08	.09
Dallas	.....	30.00	.....	13.25	20.30	.06	.103	15.00	24.80	.055	.05/.07	.07/.09
Denver	.....	27.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	35.00	.....	13.60f	18.00f	.0593	.0994	13.60	18.00	.0535	.0545	.0924
Kansas City	.....	44.00	.....	18.50	23.50	.077	.1075	.077h	.107h	.057	.11	.15
Los Angeles	.....	50.00	.....	6.50b	15.00	6.50bg	15.00bg	5.50b	.....	.0192	.0525	.1125
Minneapolis	.....	.....	1.90d	19.20	24.20	.10	.12	19.30	28.30	.056	.....	.....
Montreal	75.00	.....	3.62	14.60	21.25	.105	.1375	.101h	.121h	.07	.13	.16
New Orleans	.....	.....	.....	14.00a	19.00a	.055	.085	.06h	.09h	.....	.078	.....
New York	.....	68.00	2.75	13.50	18.50	.055	.08	.055h	.125h	.....	.07	.11
Philadelphia	120.00	42.50	2.84	14.00	19.00	.055	.08	.06h	.09h	.05	.06	.09
Pittsburgh	115.00	40.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis	110.00/121.00	37.00	.....	14.00	19.00	14.00g	19.00g	.06h	.095h	.04	.09	.125
San Francisco	.....	70.00	.....	6.50	15.00	6.50g	15.00g	7.00	17.50	.025	.0475	.117
Seattle	.....	60.00c	.....	13.69	23.49	.....	24.00g	10.00/11.00	23.50/24.50	8.34g	.0575i	.1308

‡ Delivered. a F.o.b. Baton Rouge. b Delivered to purchaser's warehouse. c 3½x4x8½ in. d 2½ in. 6 to 8-lb. treatment. e Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. f Mexican. g Per ton. h Per gallon. i F.o.b. Martinez. j 3x3½x8½ in.

(Continued on page 104)

A few facts about shovels PROVE

BIGGER VALUE at LOWER COST

when you buy a BAY CITY

By every count the BAY CITY offers you biggest shovel, crane, dragline or trench hoe value—a glance at the chart proves this beyond doubt with better weights, wider working ranges and safer crane loads plus greater power. But this is only part of the story! All BAY CITY Shovels are fully convertible *without machinery change* • have powerful one piece chain crowd with electric dipper trip • are standard equipped with "E-Z" control power operated clutches • use unit-cast alloy steel bases. Here is big value at low cost.

That, too, is only part of the story for you should not be confused with low purchase price. The real cost is measured by combining purchase price with maintenance and operating costs. BAY CITY outstanding performance will pay big dividends in your excavating and material handling. For complete information write for Catalog H-1 containing 32-pages of photos and data.

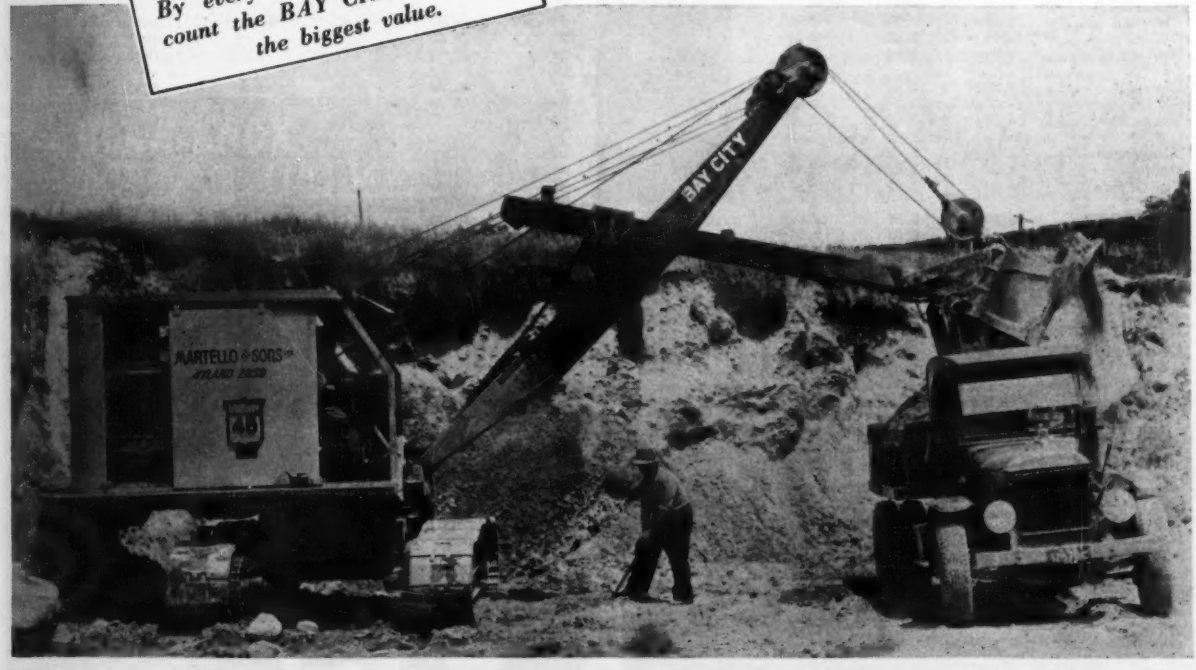
a few FACTS *about 3/4 yard*

Shovels - Cranes - Draglines

	BAY CITY Model 42	BAY CITY Model 45	Average* ¾ Yard
Weight	42,000	44,400	36,915
Boom Length	18'0"	19'0"	17'9"
Dipper Sticks	13'0"	14'3"	13'11"
SHOVEL			
Dump Height	15'2"	16'10"	14'10"
Dump Radius	23'3"	24'2"	22'3"
Dig Radius	36'6"	27'11"	25'11"
CRANE SAFE LOADS			
12' Radius	17,000	20,000	15,715
20' Radius	8,350	9,700	7,770
30' Radius	4,700	5,700	4,490
Crawler Length	12'0"	12'6"	10'11"
Piston Displace.	517	520	443

*Based on available data from 10 other mfrs. of ¾ yd. jobs.

By every dipper-full and every count the BAY CITY offers you the biggest value.



Martello & Sons, Toronto contractors, said "A BAY CITY for Mine in '39" switching from another make and are highly pleased with the outstanding performance of this "Caterpillar" Diesel job. BAY CITY performance plus low cost maintenance and operation has resulted in constant increase in sales. 1937 *was* the biggest year in the history of our company. Then 1938 took the lead *and now* 1939 sales already exceed all previous years. Put yourself in line for bigger P-R-O-F-I-T-S in 1940 with a BAY CITY.

BAY CITY SHOVELS, INC., BAY CITY, MICHIGAN

Export Office: H. M. Hein, 330 W. 42nd St., New York, N. Y. (Oparo)

BAY CITY SHOVELS

(Continued from page 102)

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet *b*	RIVETS ½-in. structural	WIRE NAILS Base *d*	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle Bars	Std. Spikes *c*	Tie Plates *c*	Track Bolts
Birmingham	$2.10	$2.15	$3.40	$2.55	....	$40.00	$40.00	$39.00	$2.70	$3.00	$2.15	$4.15
Chicago	2.10	2.15	3.40	2.55	$2.40	40.00	40.00	39.00*e*	2.70	3.00	2.15	4.15
Pittsburgh	2.10	2.15	3.40	2.55	2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Buffalo	2.10	2.15	....	....	2.40	....	....	....	....	....	2.15	....
Cleveland	2.10	2.15	3.40	2.55	....	....	....	....	....	....	....	....
Youngstown	....	2.15	....	....	....	....	....	....	....	3.00	....	....
Detroit	....	2.25‡	....	....	....	....	....	....	....	....	....	....
Gulf ports	2.45*a*	2.50*a*	....	....	2.85*a*	....	....	....	....	....	....	....
Pacific ports	2.70*a*	2.60*a*	....	....	2.90*a*	....	....	....	....	3.00	2.25	....

‡ Delivered. *a* F.o.b. cars dock. *b* Rail steel same as billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per c.l. *e* Re-rolled price withdrawn; market unsettled with scrap advance.

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS* Per 100 lb., ¼ in., base price 15 tons or over *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH—Per 100 sq.yd., carload lots— Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING—Per 100 s.f., carload lots— 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No. 6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb. base price
Atlanta	$2.34	$2.39	$2.39	.02½	.10	$21.00	$23.00	$1.82	$1.35	$0.1719	$3.04
Baltimore	3.60	2.85	2.70	.....	.10	20.50	22.50	1.70	1.27	.1611	2.70
Birmingham	2.10*a*	2.15	2.15	.02½	.10	19.50	21.50	1.80	1.34	.1701	....
Boston	4.00	2.73	2.58	$20 C.L.	.10	21.50	23.50	1.76	1.31	.1656	3.14
Chicago	2.10*a*	2.15	2.15	.03	.05	18.50	20.50	1.67	1.25	.1575	2.40
Cincinnati	3.68	2.51*c*	2.51*c*	.....	.05	20.50	22.50	1.66	1.25	.1566	....
Cleveland	3.58*g*	2.15	2.15	.02½	.10	21.00	23.00	1.66	1.25	.1566	....
Dallas	4.75	3.25	3.25	.....	.....	25.00	27.00	1.93	1.42	.1827	....
Denver	4.35	3.95	3.80	.....	.....	23.50	25.50	1.97	1.45	.1863	....
Detroit	3.80‡	2.60	2.45	.....	.10	22.50	24.50	1.68	1.26	.1584	2.81
Kansas City	4.03	2.51*c*	2.36*c*	.0	.05	18.50	20.50	1.78	1.33	.1683	2.86
Los Angeles	3.65*f*	2.65	2.50	.02½	.05	23.00	27.50	1.93	1.42	.1827	3.65
Minneapolis	3.80‡	2.48*c*	2.48*c*	.0	.10	21.50	24.50	1.80	1.34	.1701	2.73*d*
Montreal	3.80	2.65	2.55	.....	.....	26.00	28.50	2.99	2.08	.319	3.95
New Orleans	4.40	2.52	2.52	.05	.10	21.50	23.50	1.82	1.35	.1719	2.875
New York	3.75	2.39	2.39	.....	.10	20.50	22.50	1.72	1.29	.1629	2.74
Philadelphia	3.55	2.66	2.56	.....	.....	19.50	21.50	1.71	1.28	.1611	2.72
Pittsburgh	2.10*a*	2.15	2.15	.02½	.10	21.50	24.50	1.59	1.20	.1503	2.40
St. Louis	3.47	2.39	2.39	.0	.05	20.50	24.00	1.69	1.27	.1602	2.70
San Francisco	4.00	2.525	2.375	.02½	.10	23.50	25.50	1.93	1.42	.1827	3.25
Seattle	2.70*e*	2.40*e*	.....	.....	.....	25.50	27.50	1.93	1.42	.1827	2.90*e*

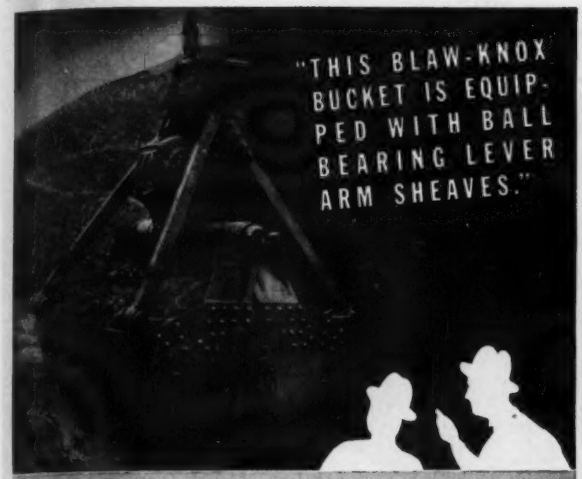
‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 30c.; 1 to 5 tons, add 10c. * High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.*a*	VITRIFIED SEWER PIPE Per foot, 8 in., s.s.	delivered 12 in., s.s.	ASTM 24 in., d.s.	C13–35 36 in., d.s.	CLAY DRAIN TILE Per 1,000 ft., carload lots, 6 in.	f.o.b. 8 in.	CONCRETE SEWER PIPE Per ft., delivered: ASTM 12 in.	C 14–35 24 in.	WROUGHT STEEL PIPE Full standard weight, *h* 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$49.40	$0.26*b**c*	$0.468*b**c*	$1.8525	$4.68*c*	$85.00	$128.00	$0.45	$1.025	62.2	54.2	59.7	51.2
Baltimore	52.80	.30	.55	2.30	6.80	110.00	150.00	.40	1.60	65.5	57.5	63.0	54.5
Birmingham	45.00	.25	.45	1.625	4.66	85.00	220.00	.40	1.60	62.2	54.2	59.7	51.2
Boston	55.00	.294	.567	2.16	6.15	199.00‡	288.00‡	.50	2.50	64.1	56.1	61.6	53.1
Chicago	53.80	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.48	67.0	59.0	63.5	55.0
Cincinnati	52.70	.259	.4995	1.935	5.6375	75.00	120.00	.60	1.90	65.9	57.9	63.4	54.9
Cleveland	54.24	.224	.432	1.665	5.0225	69.00	108.00	.35	1.50	67.8	59.8	65.3	56.8
Dallas	58.20	.265	.477	1.728	4.70	80.00	100.00	.46	1.57	59.9	51.9	57.3	48.3
Denver	60.60	.24†	.52†	2.16†	.....	130.00	240.00	.....	.....	58.4	50.4	55.7	47.2
Detroit	54.24	.147	.2835	1.215	4.70	66.45	111.40	.162	1.125	66.3	58.3	63.8	55.3
Kansas City	55.12	.30	.54	2.16	5.00	120.00	240.00	.45	1.60	62.9	54.9	60.0	51.5
Los Angeles	55.00	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	56.8	47.8	54.3	44.8
Minneapolis	57.20	.24†	.432†	1.728†	4.60†	.....	.....	.70	1.80	64.2	56.2	60.7	52.2
Montreal	60.00	.55	.90	3.15	5.10*e*	135.00‡	260.00‡	.48	1.92	.....	.....	.....	.....
New Orleans	51.38	.26	.48	1.69	.....	150.00	220.00	.37	2.10	62.4	54.4	58.8	50.3
New York	52.20	.32	.63	2.52	6.45	.....	.....	.50	1.20	64.9	56.8	62.4	53.9
Philadelphia	50.90	.21	.405	1.75	5.05	100.00	160.00	.54	1.80	65.3	57.3	62.8	54.3
Pittsburgh	55.60	.245†	.4725†	1.845†	5.4325	97.80	154.20	.85*g*	2.00*g*	68.5*i*	60.5*i*	66.0*i*	57.5*i*
St. Louis	52.48	.26	.504	2.016	3.96	85.00	170.00	.75*j*	1.80*k*	65.1	57.1	62.0	53.5
San Francisco	55.00	.3275*d*	.5895*d*	2.358	5.895	107.25	178.75	.45	2.50	.....	.....	.....	.....
Seattle	55.35	.35	.63	2.52	6.30	72.00	175.00	.45*f*	1.40*f*	.....	.....	.....	.....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N. J. (base) $49.00. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ½ in., 8½c.; ¾ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. *i* Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less. Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Butt-weld — 1 in. and 1¼ in. black 34, galv. 19; 1½ in. black 38, galv. 21½; 2 in. black 37½, galv. 21. Lapweld — 2½ in. to 3½ in. black 31½, galv. 17½ in.; 4½ in. to 8 in. black, 32½ galv. 20. *j* Reinforced; spec. C 76-37. *k* Reinforced; spec. C 75-37.

(Continued on page 106)



As a matter of fact this feature is standard equipment and does not cost more. It is especially desirable where the bucket handles loose granular materials because it keeps lubrication in and dirt out. This and many other desirable features of Blaw-Knox Buckets is fully described and illustrated in Bulletin No. 1606. Write for it today. 17

BLAW-KNOX Digging and Rehandling BUCKETS
BLAW-KNOX DIVISION OF BLAW-KNOX CO. Farmers Bank Bldg. Pittsburgh, Pa.

For compacting earth fills—the practical design of Blaw-Knox Sheepsfoot TAMPING ROLLERS appeals to contractors because they give uninterrupted service and meet all modern specification requirements.

The roller units are full floating, on husky frames—built for long, hard use.

Send for complete details and prices.

BLAW-KNOX DIVISION of Blaw-Knox Co.
FARMERS BANK BLDG. PITTSBURGH, PA. 19

BLAW-KNOX TAMPING ROLLERS

"Yes—we get both wet and dry batches from this BLAW-KNOX CENTRAL MIXING PLANT
It gives us both mixed concrete and dry batches for compartment trucks or truck mixers."

No matter how varied and involved the concrete requirements on your job might be—Blaw-Knox will design a Central Mixing Plant to solve your problems economically.

Stationary or floating plants, manual or automatic in operation, have been furnished for hundreds of jobs. See them in Catalog No. 1566. 14

BLAW-KNOX CENTRAL MIXING PLANTS
BLAW-KNOX DIVISION OF BLAW-KNOX CO. Farmers Bank Bldg. Pittsburgh, Pa.

To quickly and accurately measure AGGREGATES, CEMENT AND WATER, Blaw-Knox Weighing Batchers are standard equipment in widespread use by road contractors, for general construction, material yards, and ready mixed concrete plants. They satisfy all modern specifications. Furnished for manual or automatic operation.

The reliability of Blaw-Knox Weighing Batchers is acknowledged by thousands of users. Send for Catalog No. 1566.

BLAW-KNOX DIVISION of Blaw-Knox Company
FARMER'S BANK BUILDING PITTSBURGH, PA. 9

BLAW-KNOX Aggregates and Cement WEIGHING BATCHERS

(Continued from page 104)

LUMBER, TIMBER, PLYWOOD—PER M FT. B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) *All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)*									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD* Rail freight increment (See note for base price)	
	1x6,[S&S]	1x8,[S&S]	2x4,[S&S]	2x6,[S&S]	2x8,[S&S]	2x10,[S&S]	3x12,[R&S]	6x12,[R&S]	12x12,[R&S]	2x12,[R&S]	12x12,[R&S]	⅜"	¾"
Atlanta	**$19.00**	**$19.00**	**$18.00**	**$20.00**	**$19.50**	**$21.00**	**$26.00**	.....	.....	**$38.50**	**$50.50**	**$17.75**	**$21.60**
Baltimore	**29.00**	**30.50**	**35.50**	**34.50**	**35.00**	**36.00**	**43.50**	.....	.....	66.00	67.00	17.35*g*	21.15*g*
	31.00	*31.00*	*35.00*	*33.00*	*33.00*	*33.00*	*43.50*	*$43.50*	*$39.00*	.....	.....	.....	.....
Birmingham	**22.50**	**23.50**	**22.00**	**21.00**	**22.00**	**23.00**	**37.00**	**36.00**	**36.00**	.....	.....	16.25	19.85
[1]	25.50	25.50	29.00	27.00	29.00	40.00	60.00	.....	.....	52.00	60.00	.....	.....
Boston	**32.00**[3]	**32.00**[3]	**34.00**[3]	**34.00**	**53.00**[4]	**63.00**[4]	**77.00**[4]	.....	.....	**77.00**	**77.00**	**17.35***g*	**21.15***g*
	29.00	*29.00*	*34.00*	*34.00*	*36.00*	*36.00*	*45.00*	*45.00*	*50.00*	.....	.....	.....	.....
Chicago	**33.00**	**34.00**	**34.00**	**34.00**	**34.00**	**35.00**	**50.00**	.....	.....	**80.00**	**90.00**	**13.15**	**16.05**
	37.00	*37.00*	*40.00*	*38.00*	*40.00*	*41.00*	*44.00*	*43.00*	*43.00*	.....	.....	.....	.....
Cincinnati	**31.50**	**33.00**	**30.50**	**31.00**	**32.00**	**35.00**	**44.50**	.....	.....	**53.00**	**56.00**	**16.25**	**19.85**
	.....	.....	.....	.....	.....	.....	*46.00*	*46.00*	*46.00*	.....	.....	.....	.....
Cleveland	**33.00**	**33.50**	**33.00**	**33.50**	**35.00**	**37.00**	**44.00**	46.00	46.00	**80.00**	**80.00**	**16.65**	**20.25**
Dallas[e]	**28.50**	**32.00**	**31.50**	**29.00**	**30.50**	**32.50**	**52 50**	**52.50**	**52.50**	**63.50**	**71.00**	**13.90**	**16.95**
Denver[‡]	**44.00**[4]	**42.00**[4]	**40.00**[4]	**43.00**[4]	**48.00**[4]	**43.00**[4]	**48.00**[4]	**60.00**[4]	**71.50**[4]	.....	.....	**9.90**	**12.05**
Detroit	**35.00**	**35.00**	**35.00**	**35.00**	**38.50**	**42.00**	**46.00**	.....	.....	**43.50**	**58.00**	**16.25**	**19.85**
	.....	.....	.....	.....	.....	*46.00*	*47.00*	*54.00*	*54.00*	.....	.....	.....	.....
Kansas City	**29.00**	**31.00**	**30.00**	**28.50**	**29.00**	**31.00**	**35.00**	.....	.....	**55.00**	**60.00**	**12.25**	**14.95**
	29.00	*30.00*	*30.00*	*28.50*	*29.00*	*30.00*	*35.00*	*39.00*	*39.00*	.....	.....	.....	.....
Los Angeles [a]	*36.00*	*35.00*	*36.00*	*33.00*	*33.00*	*33.00*	*38.00*	*46.00*	*59.00*	.....	.....	**9.35***gh*	**11.35***gh*
Minneapolis [‡b]	**47.00**[5]	**47.00**[5]	.....	.....	.....	.....	.....	.....	.....	.....	.....	**12.05**	**14.70**
[‡]	*38.00*	*38.00*	*39.00*	*39.00*	*39.00*	*39.00*	*59.00*	*59.00*	*59.00*	.....	.....	.....	.....
Montreal [b7]	*44.00*	*44.00*	*49.00*	*47.00*	*48.00*	*58.00*	*84.00*	.....	.....	*155.00*	*165.00*	.....	.....
	40.00	*40.00*	*40.00*	*40.00*	*40.00*	*41.50*	*41.00*	*40.00*	*39.00*	.....	.....	.....	.....
New Orleans	**24.00**	**25.00**	**25.00**	**24.00**	**24.00**	**25.00**	**46.00**	.....	.....	**62.00**	**69.00**	**13.90**	**16.95**
	29.00	*29.00*	*32.00*	*33.00*	*35.00*	*34.00*	*36.00*	.....	.....	.....	.....	.....	.....
New York [‡]	**38.00**	**39.00**	**37.00**	**36.00**	**38.00**	**39.00**	**42.00**	.....	.....	80.00*f*	82.50*f*	17.35*g*	21.15*g*
[‡]	.....	.....	*45.00*	*45.00*	*45.00*	*45.00*	*45.00*	*47.50*	*47.50*	.....	.....	.....	.....
Philadelphia	**24.00**	**24.50**	**25.50**	**25.50**	**27.50**	**27.50**	**29.00**	.....	.....	**55.00**	**57.50**	**17.35***g*	**21.15***g*
	35.00	*36.50*	*39.00*	*38.25*	*39.00*	*39.00*	*44.00*	*32.00*	*32.00*	.....	.....	.....	.....
Pittsburgh	**38.10**	**39.90**	**47.05**	**42.00**	**45.65**	**46.90**	**59.70**	.....	.....	.....	.....	**17.00**	**20.70**
	51.90	*49.60*	*49.60*	*49.00*	*48.90*	*49.25*	*66.55*	*66.55*	*66.55*	.....	.....	.....	.....
St. Louis [‡c]	**33.00**	**34.00**	**32.00**	**31.00**	**32.00**	**33.00**	**48.00**	*52.00*	*52.00*	**73.00**	**72.00**	**13.90**	**16.95**
San Francisco [d]	*22.50*	*22.00*	*22.50*	*22.50*	*21.50*	*21.50*	*23.50*	*23.50*	*23.50*	.....	.....	**7.30***g*	**8.90***g*
Seattle	*21.00*	*21.00*	*21.00*	*21.00*	*21.00*	*21.00*	*26.00*	*26.00*	*26.00*	.....	.....	**0.00**	**0.00**

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Pine. [6] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* At ship's tackle. *e* 10% discount taken off. *f* Up to 18 ft. *h* These are October prices; unable to obtain November or December quotations.

Nots: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ⅜", $77.00; on ¾", $84.80; price includes oiling and sealing charges. For other centers add rail freight increment from table for proper size. For resin dipped treatment, add $10.00 per M. *g* Lower rate by water shipment. *h* 50,000 lb. minimum.

* Plywood prices to hold for balance of year, but many manufacturers are out of market. Will not take future orders.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Sept. 15, 1928 Single or Double Thickness A quality	B quality	EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*	
Atlanta	75%*d*	75%*d*	$0.15	
Baltimore	83⅓*d*	82%*d*	.15	
Birmingham	89%	90%	.105	
Boston	82%*d*	82%*d*	.15	
Chicago	79%*d*	79%*d*	.15	
Cincinnati	79%*d*	79%*d*	.15	
Cleveland	88-10-10%	88-10-10%	.19	
Dallas	78%*d*	78%*d*	.165	
Denver	76-10%*d*	76-10%*d*	.15*e*	
Detroit	79-10%*d*	79-10%*d*	.15	
Kansas City	79-10%*d*	79-10%*d*	.155	
Los Angeles	86%	88%	.1575	
Minneapolis	76%*d*	76%*d*	.155	
Montreal	70-10%*ab*		.17†	
New Orleans	80%*d*	80%*d*	.16	
New York	82%*d*	83%*d*	.20*f*	
Philadelphia	82-10%	83-10%	.15	
Pittsburgh	79%*d*	79%*d*	.1425	
St. Louis	79-10%*d*	79-10%*d*	.155	
San Francisco	78%	83%	.155	
Seattle	85%	88%	.1575	

Price of 60% Ammonia Gelatin is $0.015 per lb. higher than 40%

a Disc. from list Sept. 1939. *b* Also less 6% tax exemption. *d* Discount from jobbers' list Aug. 15, 1938.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal Street, add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla.	$0.105	$0.14	$0.16
W. of Miss., to Rocky Mtn. States, and Fla	.11 –.13	.135 –.15	.155 –.17
Rocky Mtn. States	.11 –.1325	.13 –.145**	.15 –.165**
Pacific N. W. States	.1075–.115	.1375–.15	.1575–.17
Pacific S. W. States	.1050–.1175	.135 –.1475	.155 –.1625

** F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES—F.O.B.

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf — Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.18	$0.195
12 in.— 2 ft. from butt	6 in.	50 to 59 ft.	.225	.24
12 in.— 2 ft. from butt	6 in.	60 to 69 ft.	.23	.255
14 in.— 2 ft. from butt	6 in.	50 to 69 ft.	.24	.265
14 in.— 2 ft. from butt	6 in.	70 to 79 ft.	.28	.275
14 in.— 2 ft. from butt	5 in.	80 to 85 ft.	.40	.415
14 in.— 2 ft. from butt	5 in.	85 to 89 ft.	.42	.482

RAILWAY TIES

Prices f.o.b., per tie for carload lots:		6' x 8" x 8' Untr.	6' x 8" x 8' Tr.	7' x 9" x 8'6" Untr.	7' x 9" x 8'6" Tr.
Boston	Oak	$1.20	....	$1.65	....
	Pine	1.50	$2.25*a*	2.25	$3.20*a*
New York	S. L. Sap Pine	1.10/1.20	1.85	1.50	2.35
	Mixed Oak	1.45	1.95	1.90	2.45
Birmingham	White Oak	.85	1.50*a*	1.35	1.70*a*
	Southern Pine	.55*b*	1.10*ab*	.70	1.30*a*
Chicago	Oak	....	1.65*a*	....	2.25*a*
	Southern Pine	....	1.53*a*	....	2.13*a*
Los Angeles	Douglas Fir	.64	1.38*a*	.90	1.80*a*
Philadelphia	Red Oak	1.10	....	....	2.40*a*
St. Louis	White Oak	1.12	....	1.50	....
	Red Oak	1.12	1.60*a*	1.50	2.03*a*
	Sap Pine or Cypress	1.02	....	1.40	....
San Francisco	Douglas Fir	.90*bef*	....	....	1.95*caf*
Montreal	Birch or Maple	.65	1.05*a*	.75	1.35*a*

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 6' x 8" x 8'6". *c* Empty cell. *d* Zinc. *e* Green. *f* At ships tackle.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.00–2.85
Chlorine cylinders, liquid, per lb. delivered	.0525
Calcium chloride, 77–80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, delivered, per ton	22.00–35.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.10
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00
Sulphate of copper, in bbl., per 100-lb	4.75

(Continued on page 108)

30"x18" Telsmith Timken Bearing Equipped Double Roll Crusher manufactured by Smith Engineering Works, Milwaukee, Wisconsin.

ROCK CRUSHERS NEED TIMKEN BEARINGS

Telsmith Has Them

It should afford great satisfaction to purchasers of Telsmith Double Roll Crushers to know that the crushing rolls are mounted on TIMKEN Tapered Roller Bearings. That means power economy; protection against all kinds of loads—radial, thrust, shock—in any combination; permanent alignment of roll shafts and prevention of roll shaft wear; constant trouble-free operation; low maintenance cost; and long crusher life.

Rock crusher service admittedly is hard on bearings, but with the inherent stamina given them by TIMKEN Electric Furnace Steel, TIMKEN Bearings are more than a match for this or any other bearing service to be found in the construction industry—in all kinds of equipment. Specify "Timken Bearing Equipped" when buying.

TIMKEN
TAPERED ROLLER BEARINGS

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

(Continued from page 106)

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	Structural clay tile — partition — scored, per M. lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	Structural clay tile — load bearing — scored, per M. lots of 2,000 pieces or over, 8x12x12 in.	10x12x12 in.	12x12x12 in.	Brick, per M. in quantity, Common backing	Straight hard	Lime, per ton, Hydrated finishing	In paper Common hydrated	Carload lot Pulverized or lump
Atlanta	$90.00	$100.00	$185.00	$220.00	$230.00	$240.00	$12.50	$16.00	$24.00	$15.50	$15.50
Baltimore	74.00	80.00	165.00	190.00	240.00	290.00	13.00*k*	16.00*k*	18.50	14.50	2.50*m*
Birmingham	78.75	84.00	157.50	189.00	201.25	242.00	15.00	19.00	25.00	17.50	2.00*o*
Boston	82.10*a*	87.60*a*	164.20*a*	186.10*a*	243.20*a*	277.90*a*	17.00*i*	20.00*i*	19.00	12.50	3.10*p*
Chicago	68.10	72.60	135.90	185.70	234.90	268.10	11.00	12.00	16.40	14.40	12.20
Cincinnati	61.40	65.30	121.90	141.50	187.30	215.20	16.00	16.00	15.90	13.00	.....
Cleveland	54.50	58.00	109.00	130.50	175.50	200.50	16.00	16.00	16.00*j*	14.00*j*	2.75*m*
Dallas	62.50	67.00	135.00	162.00	177.00	263.00	11.50*i*	13.50*i*	19.00	15.00	.95*n*
Denver	84.80	95.40	152.70	178.20	212.00	227.90	13.50	17.00	28.00*j*	17.00*j*	35.00*j*
Detroit	68.90	73.50	137.80	175.50	232.00	265.00*a*	15.70	17.00	13.50	11.75	12.75
Kansas City	64.50	66.50	86.00*c*	125.50	159.75	186.25	14.00	24.00	19.10	12.80	10.70
Los Angeles	73.50†*r*	89.50†*r*	128.00*c*†*r*	210.00†*r*	368.00†*r*	460.00†*r*	13.00	15.00	16.50	.....	17.50
Minneapolis	66.70	71.20	122.50	141.30	149.30	209.40	13.10	15.10*g*	21.00	16.00	19.00
Montreal	72.20*a*	77.50*a*	142.50*a*‡	76.00*a*	165.80*a*	248.70	20.75	28.00	23.50	17.00	1.75*o*
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	.....	18.30	12.08	14.10
New York	87.00	93.00	128.00	193.30*h*	238.80*h*	295.60*h*	13.00	.....	20.00	14.00	18.00
Philadelphia	80.50	85.90	161.10	193.30	238.80	296.60	15.00*e*	18.00*e*	15.50*g*	9.55*q*	12.05*q*
Pittsburgh	58.40	62.40	116.85	124.00	153.00	193.75	17.00	25.00	17.90	15.40	2.55*m*
St. Louis	62.00	88.00	120.00	180.00	234.00	280.00	16.00	17.00	22.00	16.00	2.30*m*
San Francisco	84.00	94.50	225.00	.....	.....	.....	14.00	17.00	.55*o*	.40*o*	2.05*m*
Seattle	100.00	110.00	220.00	.....	.....	.....	17.50*f*	17.50*f*	20.00*a*	20.00*a*	20.00*a*

† F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6 x 12 x 12 in. *d* Not load bearing. *e* 48 lb. tile. *f* Less $1.00, ½ cash 15 days, balance 30 days. *g* Selected common. *h* F.o.b. Perth Amboy, N. J. *i* 50c per M. off for cash. *j* LCL. *k* $1.00 discount if paid in 10 days. *l* Lump. *m* Per bbl., 180 lb. *n* Per sack 100 lb. *o* Per bbl., 200 lb. *p* 280 lb. bag. *q* 25-ton cars. *r* 5% discount 10 days. *s* 2% off cash. *t* 5½ x 8 x 12.

PAINT, ROOFING—F.O.B. CARLOAD LOTS

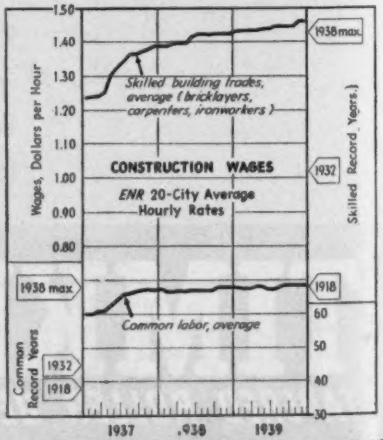
	Red lead, Per 100 lb. in 600-lb. (Approx.) Dry *a*	White lead, bbl. Per 100 lb. in oil	Ready-mixed paint, Per gal., drums, Graphite *b*	Aluminum *c*	Ferric Oxide *d*	Roofing supplies Carload lots f.o.b. factory, Rolls, slate surfaced, 85–90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 350 lb. bbl per ton
Atlanta	$9.25	$13.125	$1.30	$2.25	$1.20	$1.71	$1.65	$1.65	$0.36	$26.00
Baltimore	9.00	12.75	1.70	2.45	1.95	2.20	2.75	2.75	.45	27.50
Birmingham	9.25	13.125	2.35	2.35	1.85	1.84	1.73	1.73	.45	27.00
Boston	9.00	12.75	1.70‡	2.20‡	1.75‡	1.70‡	1.80*h*‡	1.80*h*‡	.45‡	20.00‡
Chicago	9.00	12.75	1.96	2.63	1.68	1.40*h*/	1.53*h*/	1.53*h*/	.26/	21.00/
Cincinnati	9.00	12.75	1.65	2.85	1.55	2.40	2.39*h*	2.39*h*	.36	21.00
Cleveland	9.00	12.75	1.90	2.60	1.40	1.58	1.45*h*	1.45*h*	.35	21.00
Dallas	9.00	13.50	1.88	2.11	....	2.75*h*	2.60*h*	2.70*h*	.60	....
Denver	9.50	13.25	1.65	2.40	.171	2.45	4.00	3.00	.35	18.00
Detroit	9.00	12.75	2.00	3.00	1.75	2.40	2.75	2.75	.35	27.50
Kansas City	9.00	12.875	2.15*g*	2.40*g*	1.67*g*	1.93	2.09	2.09	.25	25.00
Los Angeles	9.25	13.25	1.60	2.25	2.30	2.10	1.50	....	.45	....
Minneapolis	9.00	12.875	....	....	....	1.58*i*	1.45*h*/	1.45*h*/	.29	21.00
Montreal	9.25	9.00	2.25	2.80	2.35	2.53	1.68	1.78	.70	1.68*k*
New York	9.00	12.75	1.88	2.55	1.60	1.63	1.45*h*	1.45*h*	.23	24.00
Philadelphia	9.00	12.75	....	....	....	1.92*e*	1.99*h*/*e*	1.99*h*/*e*	.41*e*	21.00
Pittsburgh	9.00	12.75	1.05	1.95	.80	1.95	1.94*h*	1.94*h*	.34	26.00
St. Louis	9.00	12.75	1.90/2.00	2.60/2.85	1.60/2.00	1.50	1.45	1.45	.24	21.00
San Francisco	9.25	13.00	1.80	2.75	1.10/2.00	1.66	1.90	1.90	.325	20.50
Seattle	9.25	13.25	1.80	2.60	....	1.81	1.30/2.00	1.75	.35	28.00/

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* Subject to 25% discount. *f* Distributors' price to contractors. *g* 5 gal. can *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* per 100 lb. *l* per lb.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor, Building	Common Labor, Heavy Const.
Atlanta	$1.25	$1.00	$1.375	$1.00/1.25	$1.25	$0.40/.50	$0.40/.50
Baltimore	1.50	1.25	1.65	1.50	1.25	.5625	.5625
Birmingham	1.50	1.125	1.25	1.125	1.00	.30/.40*a*	.30/.40*a*
Boston	1.50	1.375	1.50	1.625	1.625	.60/.85	.60/.85
Chicago	1.70	1.625	1.70	1.70	1.70	1.025	1.025
Cincinnati	1.625	1.45	1.525	1.00/1.525	1.625	.60/.75	.60/.75
Cleveland	1.625	1.375	1.50	1.50/1.75	1.50	.90	.90
Dallas	1.50	1.00	1.25	1.00	1.50	.40/.50	.40/.50
Denver	1.65*b*	1.50*b*	1.43*b*	....	1.50*b*	.718*b*	.718*b*
Detroit	1.50	1.25	1.50	1.50	1.55	.60/.75	.60/.75
Kansas City	1.625	1.375	1.50	1.50	1.575	.85	.50
Los Angeles	1.25	1.10	1.375	1.375	1.50	.625	.625
Minneapolis	1.375	1.25*d*	1.50	1.40	1.50*e*	.85	.85
New Orleans	1.50	1.20	1.50	1.50	1.40	.40	.40
New York	1.90*b*	1.75*b*	1.925	2.00*b*	2.00*c*	1.031	.875/.95
Philadelphia	1.65*b*	1.25	1.65	1.50	1.565	.60	.60
Pittsburgh	1.75	1.50	1.50	1.25	1.75	.80	.70
St. Louis	1.50	1.25	1.75	1.57/2.00	1.58	.45/.875	.45/.875
San Francisco	1.75*c*	1.25*f*	1.50	1.50	1.60*c*	.81	.65
Seattle	1.60*c*	1.25	1.50*c*	1.50*c*	1.60*c*	.90*c*	.90*c*
Montreal	.80	.70	.75	.65	.80	.45	.40

a PWA. *b* 7 hr. day. *c* 6 hr. day. *d* 35 hr. wk. *e* 30 hr. wk. *f* Working under "stop-gap" agreement.



ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $1.463
ENR Common Average: $0.635

ACTUAL RECORDS *Prove*

GREATER STABILITY IN LONG-TIME SERVICE

"IT'S the persistence of quality that counts in an oil," says this operating manager. "We can buy plenty of oils with satisfactory characteristics as purchased, but this Gulf lubricant is the only one we have found that *retains its essential qualities* in long-time service. Its stability is truly remarkable."

Here's the real advantage you get when you use Gulf's higher quality oils: Their greater stability is reflected in the operation of your equipment. These better oils help you step up work schedules, cut down costs. Savings in maintenance alone often exceed the total cost of the lubricants.

If you are not entirely satisfied with the operation of your equipment, we suggest that you ask a Gulf engineer to check it over and recommend improved lubrication practice. He works tactfully with the men on the job, has a keen appreciation of their problems, and will help you make operating improvements. This cooperative service is extended to users of Gulf products without extra charge.

Gulf's higher quality lubricants are quickly available to you through more than 1100 warehouses in 30 states from Maine to Texas. Write or 'phone your nearest distributing point today . . . Gulf Oil Corporation—Gulf Refining Company, Gulf Building, Pittsburgh, Pa.

GULF INDUSTRIAL LUBRICATION

A COMPLETE LINE OF MORE THAN 400 OILS AND GREASES FOR INDUSTRY

HIKE PROFITS ON THOSE Large Tunnel Jobs

There is a low-cost ARMCO Liner Plate for virtually every size and shape of tunnel. This horseshoe design serves as an intercepting sewer for a large eastern city.

You no longer need heavy, bulky liner for large diameter tunnels. ARMCO Steel Plate lining will do the job and save you time and money.

On a strength-weight basis ARMCO plates cost less than any other four-flange type. The corrugated and flanged design carries the load and eliminates excess weight. Work moves right along. One man can easily handle the sectional metal plates and a structural wrench is the only tool needed for assembly. Also important, there is no fire hazard when working in compressed air.

Make a full profit on that next tunnel job by using ARMCO Liner Plates. You have a choice of gages in standard plate for large tunnels or light-duty plate for small diameter jobs. Write today for prices and complete information. The Armco Drainage Products Association, 1822 Curtis Street, Middletown, Ohio.

ARMCO

ARMCO TUNNEL LINER PLATES

(*Continued from page* 98)

has been assigned the task of coordinating the department's snow-removal forces. He also will be in charge of an information service which will broadcast information as to snow on Ohio roads over the highway patrol radio stations at Findlay, Massillon, Wilmington and Cambridge.

HARRY STEDMAN, city traffic engineer at Des Moines, W. O. PRICE, safety engineer with the Iowa State Highway Commission, and R. A. MOYER, associate professor at Iowa State College, have been appointed members of the Iowa advisory committee on public safety education.

HARRY RAGER, engineer for Tama County, Iowa during the last eight years, has resigned to accept a position with B. L. ANDERSON, road contractor of Cedar Rapids, Iowa.

A. A. TURNBULL, engineer with the New Brunswick Telephone Co., is in command of a unit of the Royal Canadian Engineers stationed at St. John, N.B. The Royal Engineers are in charge of construction, reconditioning and remodeling of all quarters for military use in Canada.

L. J. SVERDRUP, a member of Sverdrup & Parcel, St. Louis consulting engineers, has been employed by PWA to make a special study of the design of the Lake Washington pontoon bridge, which is being built by the Washington Toll Bridge Authority at a cost of $8,432,000.

LT. COL. H. G. THOMPSON is serving as commanding officer for the No. 2 Army Field Workshop, Royal Canadian Army Ordnance Corps. Colonel Thompson graduated from the University of Toronto in 1922 and since then has been engaged in engineering work in Montreal and Toronto. Recently he was employed by the Canadian Vickers Co. Ltd.

LT. COL. S. D. SCOTT of the Little Rock office, U. S. Engineers, has been assigned to field work in New Mexico, Oklahoma, and Kansas on the Cimarron River.

JOE HUDDLESTON, assistant state supervisor of the WPA information service in Louisiana during the past 3 years, has accepted the position at Fort Worth, Tex. as regional director of an FHA information service. In his new work he will be in charge of Region No. 6 which is comprised of Arkansas, Louisiana, Mississippi, Texas, Oklahoma and New Mexico.

LT. COL. XENOPHON PRICE, district engineer of Duluth, Minn., U. S. Engineers, has been ordered to make a field investigation of the feasibility of establishing a harbor of refuge at Marquette, Mich. for small craft on the Great Lakes.

C. H. ROMEISTER, superintendent of the Auburn, Ind. city light and water department, has been appointed supervisor of Auburn's new sewage treatment plant.

I. R. TAIT, assistant engineer since 1929 for the Canadian Industries Ltd., Montreal, has been made chief engineer.

MEETINGS

MEXICO DEPARTMENT OF PUBLIC HEALTH, first national convention of sanitation engineers, Mexico City, Dec. 18-20.

REGIONAL AND LOCAL

EASTERN PHOTOELASTICITY CONFERENCE, Massachusetts Institute of Technology, Cambridge, Mass., Dec. 9.

ASSOCIATION OF WESTERN STATE ENGINEERS, Denver, Colo., Dec. 12-13.

ASSOCIATED GENERAL CONTRACTORS, Nebraska building chapter, annual meeting, Omaha, Nebr., Dec. 13.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Carolinas branch, annual convention, Columbia, S. C., Dec. 14-15.

INDIANA SOCIETY OF PROFESSIONAL ENGINEERS, annual fall convention, Indianapolis, Dec. 15.

AMERICAN WATER WORKS ASSOCIATION, New York Section, winter meeting, Commodore Hotel, New York City, Dec. 28.

ASSOCIATED AMERICAN GENERAL CONTRACTORS, Central Branch, annual convention, Des Moines, Iowa, Jan. 10-11.

KANSAS CONTRACTORS ASSOCIATION, Kansas City, Mo., Jan. 11-12.

LOUISIANA ENGINEERING SOCIETY, fifth annual meeting, St. Charles Hotel, New Orleans, Jan. 12-13.

ENGINEERING CONGRESS, University of Colorado, Boulder, Colo., Jan. 18-19.

ELECTIONS AND MEETINGS

BARRY WATSON, civil engineer and registrar of the Association of Profes-

sional Engineers of the Province of Ontario, was recently chosen secretary-treasurer of the Dominion Council of Professional Engineers.

L. E. ORTH was elected president of the Muskingum Valley Society of Registered Engineers and Surveyors at the society's recent annual meeting at Marietta, Ohio. Cecil Stacy is the retiring head.

CARL A. HECHMER, sanitary engineer of the Washington (D. C.) Suburban Sanitary Commission, has been awarded the Fuller Award for the Four States section of the American Water Works Association. Hechmer joined the commission in 1918 soon after it was organized.

AT THE ANNUAL meeting of the Arizona Section of the American Society of Civil Engineers held recently in Phoenix the following new officers were elected: Vic H. Housholder, district sales engineer for Armco, president; Julian Powers, engineer of materials with the Arizona State Highway Department, first vice-president, and John H. Gardiner, engineer with the U. S. Geological Survey, second vice-president. W. T. Wishart continues as secretary-treasurer.

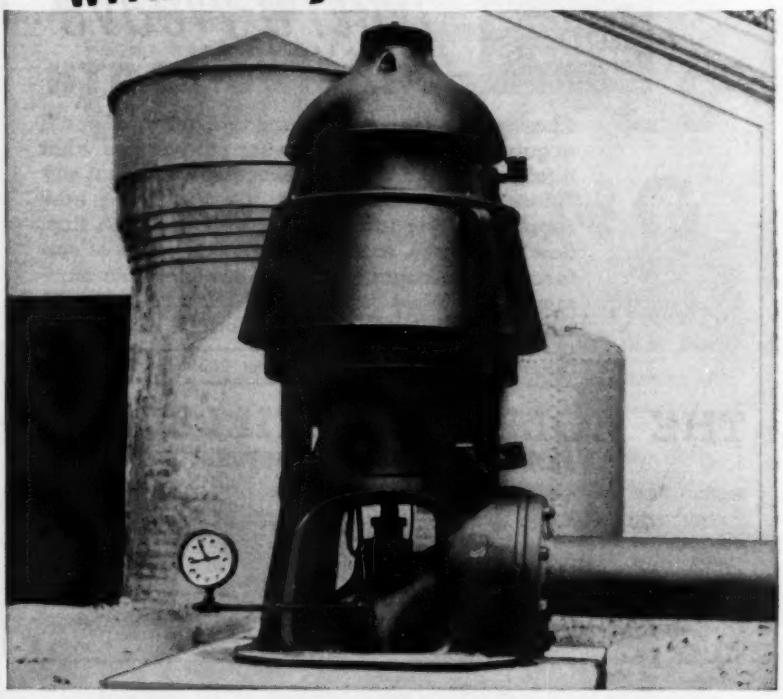
THE ENGINEERING SOCIETY of the University of Toronto on Nov. 22 held its fiftieth annual dinner and had as a guest speaker C. D. Howe, federal minister of transport in Canada. Howe, in speaking to an audience of nearly 600, gave a description of the way Canada is participating in the present war and, as an engineer speaking to engineers, dealt with the importance of engineering in the war.

THE CONVENTION of the National Housing Officials Association scheduled for New Orleans Dec. 6–8 has been cancelled and a business meeting is planned instead, according to L. Kemper Williams, president of the association. A business meeting will probably be held in December in Cincinnati or some other centrally located city.

GEOFFREY STEAD was the main speaker at a recent meeting of the St. John branch of the Engineering Institute of Canada. Sydney Hogg, a delegate of the local branch to the maritime engineering convention at Pictou, N. S., gave an official report of the convention. H. F. Morrisey, chairman of the local branch and district engineer for the dominion department of marine and fisheries, presided.

MEMBERS of the Lower Tennessee Valley Association Dec. 4 held a get-

Twice THE WATER WITH One Third THE POWER!



Fairbanks-Morse Turbine Pump Cuts Costs for Lake Providence

For almost a quarter of a century Lake Providence, La. has been faithfully served by Fairbanks-Morse equipment in its municipally owned power, water, and sewage disposal plants. Small wonder, then, that the town has replaced its outmoded air-lift pumping system with a Fairbanks-Morse Fig. 6920 12-in. 3-stage turbine pump.

When the F-M Turbine pump—driven by a 40-hp. F-M ball-bearing, weatherproof motor—was first tested, it delivered more than 900 g.p.m. This is over *two-and-one-half times* the aggregate capacity of the air compressors it replaced. The pump's rated capacity is 800 g.p.m. against a total head of 120 feet at 1750 r.p.m.—and it uses only *two thirds of the power* consumed by the 60-hp. motors that operated the old air-lift system!

In thousands of installations requiring outstanding efficiency at low operating cost, Fairbanks-Morse pumps are first choice. A wide range of types and sizes makes it possible for you to select an F-M pump ideally fitted for practically any job. Fairbanks-Morse engineers will be glad to co-operate with you. Write Fairbanks, Morse & Co., Dept. 28, 600 S. Michigan Ave., Chicago, Ill. Branches and service stations throughout the United States and Canada.

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together celebration at TVA's Gilbertsville Dam. Luther Draffen, Calvert City, Ky., is president of the group.

TOTAL ATTENDANCE numbered 55 at the Nov. 17 meeting of the Sewage Works Operators Association of Southeastern Pennsylvania, which was held at Lancaster, Pa. New officers elected are: George H. Boone, Norristown, president; Joseph P. McDonald, Lancaster, vice president; Eugene B. Swinehart, Pottstown, treasurer, and George J. Weist, Lancaster, secretary.

MORE THAN 100 members of the Pennsylvania branch of the AGC attended the branch's first annual loyalty dinner and business session at Harrisburg Nov. 21. Promotion of a safety campaign among contractors was discussed and the group decided upon a safety program. Speakers at the dinner included Richard P. Brown, Pennsylvania Secretary of Commerce; E. P. Palmer, past president of the National Association; John Coyne, president of the Building and Construction Trades Department of AFL, and Edward J. Harding, managing director of the National Contractors' Association. Frank St. Clair, Jr., chairman of the advisory committee, presided. New officers are: Frank St. Clair, Jr., president; John Wilson, Johnstown, vice president; Charles F. Puff, Jr., Harrisburg, executive secretary and general manager, and H. B. Alexander, Harrisburg, treasurer.

GRANT K. BORG was recently elected a member of the board of directors of the junior forum of the Utah Section, American Society of Civil Engineers. He succeeds R. C. Haven, Jr. Elmo R. Morgan automatically became senior director of the forum when Haven's term expired.

ABOUT 40 members attended a recent meeting of the Engineers Club of Western North Carolina held Nov. 20 at Asheville. Cyrus W. Rice, consulting engineer of Pittsburgh, Pa., E. D. Burchard, U. S. Geological Survey, and P. W. Frisk, Asheville, were the speakers.

AT A RECENT MEETING of the Vancouver Branch of the Engineering Institute of Canada, C. E. Webb was elected chairman. Other officers are: W. O. Scott, vice-chairman; T. V. Berry, secretary-treasurer.

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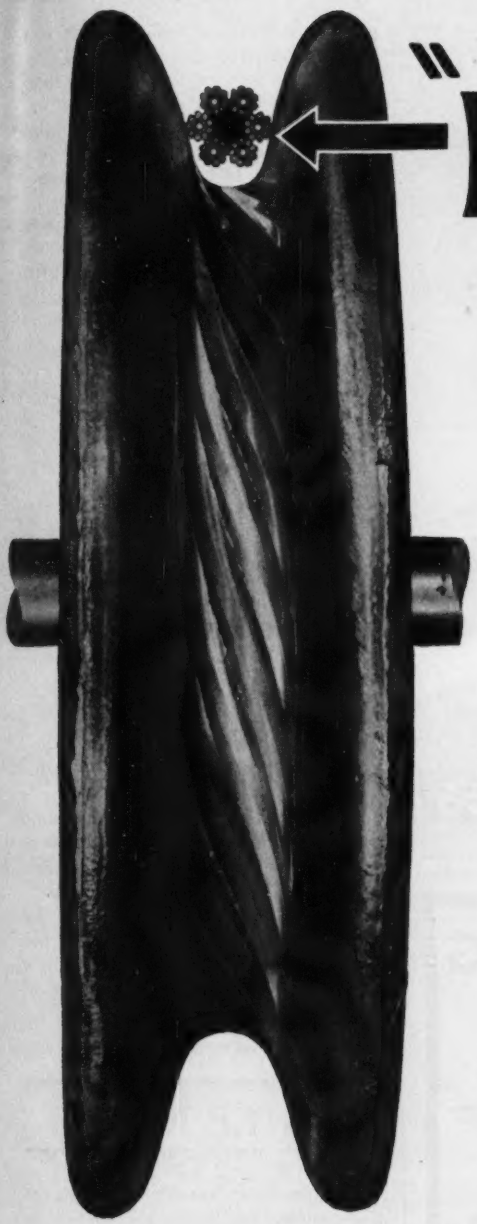
Portland Engineer Wins Bridge Design Contest

William D. Smith, civil engineer with the U. S. Forest Service at Portland, Ore., has been given the $500 first



"PINCHED" WIRE ROPES DIE YOUNG

This sheave was originally made to carry a 1¼-inch wire rope without excessive wear. It did—at first. But the rope wore—and as it got smaller in diameter it wore the sheave groove narrower at the bottom.

Eventually the rope was replaced with a new one, also 1¼-inch in diameter. And what happened? The bottom of the groove didn't fit the rope. It was too small. It pinched the rope—caused excessive wear, and the operator wondered at the short life of the rope.

If the sheave were of soft material like the one illustrated, corrugations worn in the bottom and sides of the groove by the old rope would add their damaging effect to the pinching.

To prevent unnecessary wear on your wire ropes, be sure that all sheave grooves fit the ropes.

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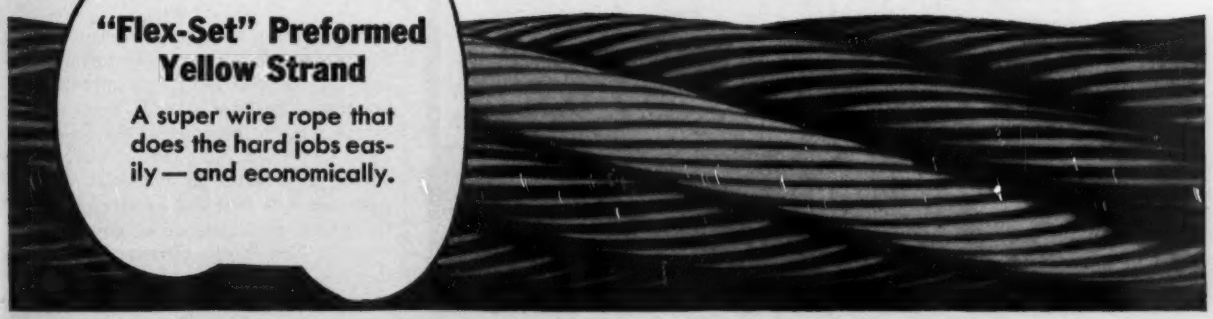

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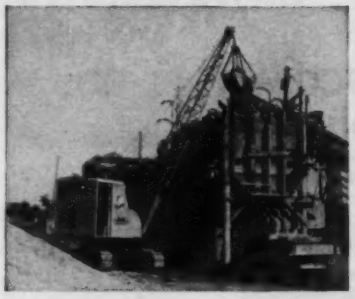

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prize in the timber bridge design contest sponsored by the American Forest Products Industries, the National Lumber Manufacturers Association, and the Timber Engineering Co. The winning entry was the design of a 70-ft. pony truss with an 18-ft. roadway, designed for an H-10 loading.

The contest was open to architects, engineers and students both in the United States and Canada, first prize in the student contest being won by Daniel Burnett of Vancouver, B. C.

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Alabama Establishes Public Safety Department

Alabama is remodeling its state highway patrol into a department of public safety under a 1939 legislative act. Alabama will be the ninth state to establish a state police agency with more than highway patrolling powers.

• • •

Bond Sales May Delay $1,300,000 Hawaii Work

Difficulty in selling a $1,300,000 bond issue may delay a large waterworks program for rural sections of Oahu, Hawaii. Half a dozen New York bonding houses had made known their intention of bidding on the issue but when war began all these firms notified the authorities they would not bid at the opening.

BRIEF NEWS

MISSOURI now has 15,531 miles of roads, according to an announcement of the Missouri State Highway Department. The report also shows that 99.5 per cent of the trunk system as established by the Centennial Road Law of 1921 has been brought up to the standard originally adopted or subsequently amended. Of the total mileage, 7,200 miles is farm-to-market roads.

WITH POWER EQUIPMENT operating at 70 per cent efficiency, a potential water power of 42,900,000 hp. is available 90 per cent of the time in the U. S., according to a recent estimate of the Geological Survey. Washington stands first among the States in potential water power, and is followed by Oregon and California, which are about equal, and next by New York. Fifty per cent of the time 57,400,000 hp. would be available.